THE GLASS INDUSTRY

VOLUME 25, NUMBER 6, JUNE, 1944

A CALCULATOR FOR COMPUTING THE SPECTRAL TRANSMISSION OF GLASSES AT DIFFERENT THICKNESSES

By T. C. VAUGHAN

The circular scales accompanying this article, appearing on pages 278 and 279, reproduced in exact calibration, may be used as patterns for the construction of a calculator for computing the spectral transmissions of colored glasses for various thicknesses.*

It is customary to report transmission data of colored glasses for some standard thickness, such as two millimeters. The samples used for the measurements are seldom of the desired thickness. Therefore, it is necessary to correct the results, for the effect of thickness, according to the equation:

$$\log \frac{T_2}{(1-R)^2} = \frac{t_2}{t_1} \log \frac{T_1}{(1-R)^2}$$

where T_1 and T_2 are transmissions corresponding respectively to thicknesses t_1 and t_2, and R is determined from the Fresnal equation $R = \frac{(n-1)^2}{(n+1)^2}$, n being the refractive index of the glass.

Because the range of compositions used for commercial container and window glasses is relatively narrow, it is possible to assign a constant value 0.92 to $(1-R)^2$. This simplifies the use of the equation but still necessitates a great amount of calculation when a number of points are used in establishing a complete curve of spectral transmission.

The scales of the calculator are derived from figures obtained by the use of the equation. Use of the calculator eliminates all of the tedious computation normally required.

To construct a calculator, mount the scales "A" and "B" on pieces of stiff paper or cardboard. Trim the scale (B), of smaller diameter, to exact size. Punch a small hole in the center of each, large enough to accommodate a suitable pivot. Using "C" as a pattern, cut an index arm from a piece of transparent plastic. Rule a line lengthwise of the index arm, using a sharp-pointed instrument, and fill in the line with India ink so as to make it easily visible. Punch a hole near the large end being certain that the line passes through the center of the hole.

Assemble the calculator in "A-B-C" order using a suitable pivot to hold the parts together. The assembly should be tight enough to prevent accidental motion of the parts. The calculator is now ready for use.

The outer scale (A) is read in units of thickness, millimeters, fractional inches or any other convenient units. The inner spiral scale (B) designates the percentage transmission from 0.1 to 91.5.

Assume that for a given wave length the transmission is 8.3 per cent for a sample thickness of 2.74 mm. and that the transmission at 2.0 mm. is desired. Align the index arm with 8.3 on the inner spiral scale and with 2.74 on the outer scale. Holding the scales stationary, move the index arm to 2.0 on the outer scale and read 15.9 on the inner scale. The transmission for a thickness of 2.0 mm. is therefore 15.9 per cent.

In using the calculator for sample thicknesses measured in thousandths of an inch, some difficulty may be encountered because of the limited range of the thickness scale. Suppose the transmission is 12.5 per cent for a sample thickness of 0.118 inches and that the transmission at 0.075 inches is desired. It is not possible to make settings directly for the two thicknesses. However, both thicknesses can be multiplied or divided by the same number without altering their ratio. Multiplying by 20, 0.118 becomes 2.36, and .075 becomes 1.50. Align the index arm with 2.36 on the outer scale and with 12.5 on the inner. Slide the index arm to 1.5 on the outer scale and read 26.0 on the transmission scale. The transmission at 0.075 inches is 26.0 per cent.

The accuracy of a properly assembled calculator is satisfactory for most purposes. Experience with a large number of sample calculations indicates that the maximum error is less than 0.5 per cent of the transmission-scale reading. The time required for a single calculation is a few seconds, and a complete transmission-curve represented by a large number of points can be reduced to standard thickness in a matter of minutes.

*A contribution of the Hartford-Empire Company.

CARE AND REPAIR OF COMPRESSED AIR EQUIPMENT

PART I

EDITOR'S NOTE: The importance of taking the proper care of heavy equipment regardless of the state of the times cannot be overstressed. In the automatic branch of the glass industry this is particularly true of the air compressor, the proper care and maintenance of this type of equipment being highly essential if production is to be kept at capacity loads. This article on the care and repair of compressed air equipment is based on data from the publications of the Compressed Air Institute and the Manual of Engineering Instructions issued by the U. S. Navy Department. This first installment deals with the maintenance and repair of the compressor proper. Part II, which will appear in an early issue of THE GLASS INDUSTRY will deal with the lubrication of the compressor and the care and repair of supplemental equipment such as air filters, intercoolers, aftercoolers and the like.

In the forming of glass by automatic processes the air compressor system may be said to be the heart of the operation. Any breakdown here means that the forming operation must be suspended. It is obvious then that the equipment that goes to make up a complete compressed air system, namely, compressors, compressed air lines, intercoolers, aftercoolers, and receivers, needs constant care if they are to perform their duties efficiently with the minimum of maintenance and service interruption, and thus keep the plant operating at capacity.

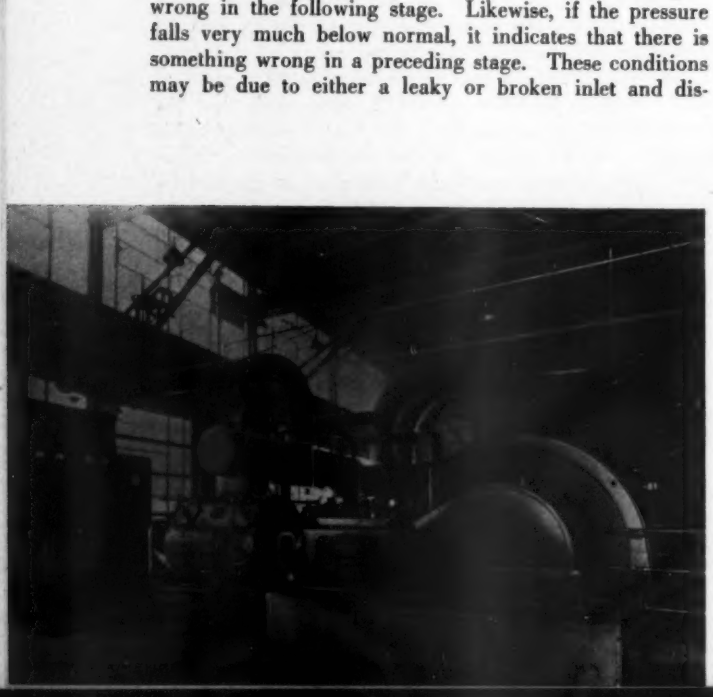
A brief review of air compressor care and repair requirements seems highly desirable even though the subject may appear to be well known. This is especially true at present as many of the "first principles" are apt to be ignored by the "pressed for time and help" maintenance department.

The most vital parts of the air compressor are the air inlet and discharge valves. Leaky valves will reduce the capacity of the compressor and result in unbalanced stage pressures. If an intercooler pressure rises very much above its normal pressure it indicates that something is wrong in the following stage. Likewise, if the pressure falls very much below normal, it indicates that there is something wrong in a preceding stage. These conditions may be due to either a leaky or broken inlet and discharge valve respectively. Another indication of valve trouble that will assist in determining where trouble lies is hot valve covers. If the intake valve covers become unusually hot, it is an indication that the inlet valve is leaky or broken. In most cases leaky valves are caused by the valves being dirty and can be eliminated by periodic inspection and cleaning of the valves and valve passages. Dirty intake air, excessive cylinder oil, improper grade of cylinder oil and high temperature of the air due to faulty cooling are the usual causes of dirty valves.

When valves are removed for cleaning or inspection then locations should be marked so that they may be replaced in the same hole from which they were removed. Do not take them apart unless their condition makes it necessary. Dirt and carbon in the ports can usually be removed without taking the valve apart. If it is found necessary to take the valve apart careful attention should be paid to the manner in which the valve is assembled so that in reassembling the proper relation of parts will be kept. Cleaning is accomplished by soaking in kerosene followed by a stiff brushing or light scraping to remove the carbon. The parts are then well dried before reassembling.

Before the cleaned valves are replaced, the valve-seat and the cover-plate gaskets should be inspected and, if necessary, replaced. Copper-covered asbestos or plain thin copper gaskets should be used. If these are not available, 1/16th inch compressed-asbestos sheet gaskets may be used temporarily. Each valve assembly is then replaced into its former location. Since many valve plates are alike for both suction or discharge, extreme care must be used to make sure that they are put in properly. Suction valves open toward the center of the cylinder while the reverse is true of the discharge valves. If a valve is reversed, very serious loss of capacity or damage may result. The valve cover is then placed on the cylinder, being sure that its gasket is squarely in place. Fasten by drawing down on the opposite cover nuts evenly and in turn so that the cover is not tilted. Tighten down the valve set screw or clamping bolt, drawing it tight to hold the valve on its seat. If special locknuts are not used to seal against thread leakage, a turn of solder or fuse wire may be placed around the screw and set down into a recess by a locking nut.

When it is necessary to inspect cylinders or pistons, the manufacturer's instruction books should be first consulted as to the proper method of removing heads, as this varies with each design. The compressor should be first drained of water. Care should be taken in removing heads particularly where metal to metal joints are involved to prevent damaging the joint. Where joints are fitted with a gasket, these can be occasionally saved by running a



Motor driven air compressor, typical of a large number required in the glass industry.

Photograph courtesy Compressed Air Institute.

blade in between the gasket and the head after the head has been lifted about ¼ inch.

In cleaning the cylinders never use kerosene, benzine or other light or low flash point oils. This is a dangerous practice and absolutely prohibited as these solvents vaporize very quickly and are easily exploded. Compressor interiors may be wiped with clean dry rags. A good method of cleaning cylinders is to fill the lubricator with strong soap suds (1 part soft soap to 15 parts water), or soda solution, allowing this to feed freely while the compressor is run slowly *unloaded* with the separator drain valves opened. This is very effective, but oil should always be fed again for 30 minutes before securing, so as to prevent the polished interior surfaces from rusting. The sight feeds in the lubricator must be refilled each time after cleaning the cylinders.

To remove trunk pistons from vertical compressors it is first necessary to remove the cylinder heads and in the case of three or four stage compressors the third and fourth stage cylinders will also have to be removed. Next turn the compressor manually to top center, then remove the lower half of the crankpin bearing or, in the case of some designs, the entire crankpin bearing box. The piston and connecting rod can then be pulled up through the cylinder. In removing the pistons from compressors fitted with cross-heads and piston rods, the general procedure is to loosen the piston rod from the cross-head and lift the piston and rod out of the cylinder.

If the piston rings need replacement, accurate measurements of the cylinder or liner should be taken to determine the exact diameter. Standard size rings may be used in oversize cylinders if the oversize does not exceed 0.003 inch per inch of cylinder diameter. If cylinder or liner is badly worn or out of round the liner must be replaced. When replacing piston rings, they should be first fitted to the cylinder to check for proper end clearance, the ends being filed until proper clearance is obtained. Fit the rings to the piston grooves making sure that the side clearance of each ring is such as to allow it to fall into the groove by its own weight. The thickness of the ring should be checked to make sure that the groove is deep enough for the ring thickness. Stagger the rings so that the ring splits or ends will not be in line. When the piston is assembled the rings may be wired tightly with soft copper wire. This will allow the ring to enter the bore without difficulty. The binding wire can be removed through the valve ports.

After replacing a piston it is necessary to check the end clearance. This is done by inserting a lead wire through a valve port or indicator connection and then jacking the compressor over so that when the piston has moved to the end of its stroke the lead will be flattened to the exact amount of clearance existing at that end of the stroke. The lead wire should be long enough so that the reading can be taken at a point near the center of the piston. This point can be determined by reference to the assembly drawing of the compressor. Proper clearances for the specific compressor generally can be found in the manufacturer's instruction book or from his assembly drawings. If not known, however, the clearance should be adjusted so that at the top end of the stroke it is about 1/64th inch greater than at the bottom end of the stroke. This will allow for expansion of the running parts when the compressor is in operation.

Air compressors supplying air in glass factory.

Photograph courtesy Compressed Air Institute.

The piston and clearance must always be measured and adjusted after removing the pistons, or after any adjustment or replacement of the main, crankpin, wrist-pin, or cross-head bearings. The method of adjusting clearance varies with different designs. In some it is accomplished by adding or removing shims in the connecting rod between the lower end of the rod and the crankpin-bearing boxes, in others by adding or removing shims between piston and socket type wrist-pin boxes. When the compressor is fitted with a screwed wrist-pin adapter it is adjusted by screwing in or backing out the adapter. In compressors in which the piston-end clearance is non-adjustable, successive tightening of the crankpin bearings will result in increased clearance until it becomes necessary to replace or rebabbitt the crankpin bearings. In double-acting pistons, fitted with piston rod and cross-head, the clearance is adjusted by turning the piston rod in or out of the cross-head. Never use a pipe wrench on the rod, instead, back off the piston-rod nut and its lock nut, jam the two nuts together and then turn the rod by means of a wrench on one of the two nuts.

Shell-type main and crankpin bearings are adjusted by taking out thin metal shims between the top and bottom halves of the bearing, removing the same number of shims from each side of the bearing. After replacing bearing caps, the stud nuts or bolts should be set up tightly and locked. The caps should be clamped down hard so they cannot work loose. After any bearing is taken up jack over the compressor to make sure no binding results. When the compressor is started up, after adjusting bearings, watch very carefully to be sure that they are not too tight and overheated. Stop the compressor occasionally, remove the crankcase covers and feel the bearings to see if they show any signs of overheating. Never loosen the bearing cap nuts to make a bearing run cool. Loose caps may result in bearing stud or bold breakage and damage to the compressor. When all shims have been removed, further adjustment is impossible and the bearing must be renewed or rebabbitted. When this is necessary it is more satisfactory to replace all the main-bearing shells and thus insure proper alignment. If one new main bearing is fitted it must be

(*Continued on page* 280)

COLORED GLASSES

A review of a Monograph by W. A. Weyl appearing in "The Journal of the Society of Glass Technology," Sheffield, England.

PART I

EDITOR'S NOTE: This review covers the first section of Dr. Weyl's Monograph on glass colors including the following phases of the paper: Unusual Colors Explained, Acidity and Basicity Gain New Meaning, Colored Glasses Classified and Color Indicators Reveal Constitution. Four more sections of the Monograph will appear in *The Journal of the Society of Glass Technology* and will, in turn, be reviewed in THE GLASS INDUSTRY. These sections are expected to deal with the single subjects of glass coloration as follows: ionic colors; sulfides, selenium, etc.; ruby glasses; fluorescence, decoloration, etc.

Upon the invitation of the glass research trust of the British Society of Glass Technology, Dr. W. A. Weyl, Director of Glass Science, Inc., and Professor of Glass Technology in State College, Pennsylvania, has prepared a monograph on colored glasses the first part of which appeared in the Journal of the Society. Certain fundamental aspects of glass technology have undergone so many changes during the past decade that even our most modern standard books contain no more than a preliminary review often in a controversial state and, therefore, not directly applicable to special problems. It appears questionable whether in the future a single volume book on glass technology will be written which could satisfy the needs of specialized glass technologists. The monographs sponsored by the glass research trust of the British Society of Glass Technology are probably precursory to the general style of comprehensive treatment with the exception of introductory texts. This has become customary in pure and applied general chemistry. In fulfilling an urgent demand and introducing a more suitable principle, the monographs of the series deserve commendation.

The field of glass color has not received particular attention in texts on glass technology simply because its weighted importance did not warrant a larger section in a volume of 500-1,500 pages. Less than ten pages are generally devoted to the subject. Still the number of specialists working on colored glass is considerable and the growing interest in color has been demonstrated by the activities of inter-society organizations in this country and in England. The work of the average man active in the field of glass color usually pertains to a highly specialized branch of ceramic or chemical engineering, physics or optics. Fundamental information for his researches on color is available mainly through dispersed sources in publications of a general physical, chemical and optical nature and rarely associated with the field of glass technology proper. As a rule, it will be noticed that summary publications on colored glasses give little information concerning the chemical composition and constitution of the glass. Reference to the original papers is necessary for information on the chemistry of glass colors. The literature on color in related fields and on the fundamental causes of color formation have never been correlated to the modern knowledge of glass. To accomplish this task is the predominant aim and merit of Dr. Weyl's monograph.

First Part Treats Constitution of Colored Glasses

While the chemistry and technology of single glass colorants is expected in the following parts of "Colored Glasses," the present issue bases the correlation of color and glass structure on a broad background. First the origin of color in inorganic substances is discussed in an easily comprehendable manner. This first section is a translation of modern color chemistry into the every-day language of the glass technologist. The origin of color is always connected with a field of force not fully saturated. Particularly deep colors are associated with the simultaneous presence of ions of two different valences of the same element. The following discussion of the constitution of glass is introduced by a general survey of the influence of the surroundings on a color center; this influence may cause broadening or a shift of the absorption bands. The author derives the modern concept of the constitution of glass first by the historical evolution of inevitable conclusions from the thermal anomalies of glass; then by the detailed analysis of recent X-ray work on silicate, borate and phosphate glasses. Except for the borate glasses based on a unit consisting of an oxygen triangle around a boron ion, all inorganic glasses are fundamentally a network of oxygen tetrahedra held together by strong central, usually tetravalent, ions such as silicon. This structure may be modified, particularly made more fusible, by weaker ions interrupting this network geometrically and energetically from "hole" positions in the network. These conditions rapidly became common knowledge of all glass scientists. The correlation to color, emphasized in many earlier publications of the author and his collaborators, is for the first time made available in the form of a summary. To a large extent, the variety of observed color differences of various base glasses is now traced to the field strength and the coordinative surrounding of ions. Hence, experience with color can be guided by definite rules for coloration. Coloring ions are described as being capable of considerable variety of effect because of their ability to participate either in the network of the glass or to act as modifying ions only.

Unusual Colors Explained

The effect of the partial replacement of Si by P, Al, Be, Zn, Ti, Sn on the color imparted by ions is of particular theoretical and practical interest. TiO_2, for instance, loosens the silica structure in such a way that coloring ions usually located in "modifying" or "hole" position may take "silicon positions" and, in this new surrounding, unfold new coloring properties. Considera-

tions of this kind are helpful in the interpretation of the unusual colors observed in glasses containing TiO_2 in combination with other colorants, especially Fe and Ce.

Sulfides, selenides and halides also occur in glasses and their chemistry in this surrounding is treated by the consideration of theoretical consequences of the replacement of oxygen by sulfur, selenium or halogen. The laws for the precipitation of the sulfides, for instance, in glasses containing some sulfur in the place of oxygen, are the fundamental factors to be studied in the field of many filter glasses; the mere presence, however, of such ions substituting for oxygen in the glass network strongly affects other ionic colors such as W. C. Taylor's green and yellowish cobalt glasses.

Acidity and Basicity Gain New Meaning

Practical glass men and ceramists have been accustomed to try to summarize experience with color variation in various base glasses by classifying these base glasses, or glazes, in terms of "acidity." In general, the "acidic" cations represent the "network formers," the "basic" cations, the "modifiers" and "amphoteric" cations "intermediates" of the modern classification. This is of particular importance for color work because in general the position in the network increases the absorptive power of the ion and because this position again is affected by that of the non-coloring ions in the glass. The position is not indicated, however, by the "acidic" or "basic" characteristics of the same ions in aqueous solutions; it is furthermore dependent on thermal history and both the modern and the older terminology are entirely relative. The author does not propose to drop the widely used terms "acidic" and "basic" glass but wishes the relative meaning of the terms to be understood and correlated more to the equally relative terms of glass forming properties rather than to the properties exhibited in liquid solutions.

Colored Glasses Classified

Weyl applies to glass the classification of organic dyestuffs according to chromophore groups. The chromophore groups in glasses are ions in different positions in the glass structure or combination of such ions. Of all possible combinations those wherein the ions are not bonded directly are excluded. The resulting systematics may be summarized and exemplified as follows:

Class	Number of Ions	Typical Glass Constituent Replaced By Chromophore	Example
1 a	1	Na	green Cu^{2+} glass
b	1	Si	brown Fe^{3+} glass
c	1	O	iodine glass—no visible change.
2 a	2	Na + O	yellow CdS glass
b	2	Si + O	green cobalt iodine glass (Taylor)
c	2	2O	amber disulphide glass
3 a	3	Na + Si + O	blue ferrous ferrite glass with Fe^{2+} — O — Fe^{3+} chromophore.

To these classes a fourth may be added where the glass acts as a solvent or dispersing phase for elemental colorants like Se, Cu, Au.

Color Indicators Reveal Constitution

In the last sections of the first part the monograph summarizes uses of known color influences to explain constitutional changes. Color indicators can be used to determine:

a) the state of oxidation, for instance with Mn^{2+};

b) the "acidity," with chromium, vanadium, manganese;

c) the coordination;

d) the electrical perturbation.

Not only color but fluorescence may be used for the same purpose.

In the first type of determination, the most interesting case is the examination of the diffusion of oxygen during annealing. The purple color of Mn^{3+} to which Mn^{2+} is oxidized reveals the progress of oxygen.

To determine the "acidity" or "basicity" of glass constituents are added until the color indicator exhibits the same color. For instance, green Cr^{3+} changes to yellow Cr^{6+} when borate glasses contained 33 per cent Na_2O or 20 per cent K_2O, phosphate glasses contained 45 per cent Na_2O or 25 per cent K_2O. This indicates the higher basicity of K_2O and the higher acidity of P_2O_5.

Nickel changes from purple to yellow when the coordination, that is, the number of surrounding oxygen ions, increases from four to six.

The broadening of absorption bands of, for instance, neodymium and manganese, measures the perturbing influence of ions, the relative perturbation exerted by ions, such as Li, Na, K.

The principles discussed in the first part are illustrated by various figures and graphs. The bibliography is given in footnotes on the page of the reference text.

The chemistry and technology of the single colorants in glass will be discussed in the following parts of the monograph.

N. J. Kreidl

GILBERT H. CORBIN NEW DISTRICT SALES MANAGER FOR PENNSYLVANIA SALT

The Pennsylvania Salt Manufacturing Company has announced the appointment of Gilbert H. Corbin, formerly Field Sales Manager of its Laundry & Dry Cleaning Division, as District Sales Manager in charge of the company's Minneapolis office.

Mr. Corbin has been associated with the company's Laundry & Dry Cleaning Division since it was established in 1940, following the purchase of the Sterling Products Company. He had been associated with the latter company for about thirteen years.

SUPREME COURT UPSETS 1932 DECREE IN HARTFORD-EMPIRE—HAZEL-ATLAS PATENT SUIT

High Court finds fraud in revising lower court's decision in favor of Hartford-Empire Company.

The Supreme Court, before recessing until its October term, handed down a five to four decision severely penalizing the Hartford-Empire Company in its case with the Hazel-Atlas Glass Company involving patent rights. In its 'close division' of opinion the majority of the Court based its decision against Hartford on the technicality that the Third Circuit Court of Appeals having "found fraud perpetrated upon it" could upset a ruling it made in 1932 in favor of the Hartford company.

The "fraud" referred to involves an article which appeared in a glass trade journal in 1926 dealing with automatic glass working machinery. This article was ostensibly written by William F. Clarke, former president of the American Flint Glass Workers Union, and was signed by him. However, it was brought out that the article actually was ghost-written by one of Hartford's patent attorneys. It may be stated parenthetically that while the Court has held that this ghost-written article constitutes "the fraud" on which the decision against the Hartford-Empire Company was based, as is generally known ghost-writing is a common practice, the "fraud" being found on the basis of the use made of the article by the Hartford company.

The majority opinion written by Justice Hugo L. Black states that the Third Circuit Court of Appeals, having found "fraud perpetrated upon it" by Hartford-Empire, could upset a ruling it made in 1932 in favor of that company. It was further stated by the majority that because of the fraud Hartford would be deprived of two victories it had won in patent suits.

The majority opinion after reviewing the circumstances relating to the "fraudulent" article further stated that at the conclusion of the patent infringement suit brought by Hartford-Empire against the Hazel-Atlas Company in 1928 the Hazel concern paid $1,000,000 to Hartford-Empire and entered into patent licensing agreements. It was also brought out in Justice Black's review that William P. Clarke, the former president of the Flint Glass Workers Union, who agreed to sign the magazine article, received $8,000 from Hartford-Empire. In the testimony at Toledo it was stated that this sum was paid Clarke partly for his assistance in connection with the article and for several other reasons.

"Indisputable proof of the foregoing facts," Justice Black stated, was brought out in the Government anti-trust suit against Hartford-Empire in 1939. It should be noted, however, that as indicated in the opinions of Justices Black and Roberts the general facts were known long before the 1939 action. It was further stated in the majority review that in 1941 Hazel-Atlas began its suit to have the Circuit Court upheld in withdrawing its former ruling and instructing the District Court to cancel the decree in favor of Hartford-Empire.

On this point the review of the majority opinion stated:

"Federal courts, both trial and appellate, long ago established general rule that they would not alter or set aside judgments after expiration of term at which judgments were finally entered, but judgment has never been regarded as completely immune from impeachment after term since there is rule of equity that under certain circumstances, one of which is after-discovered fraud, relief will be granted against judgments regardless of term of this entry; equity courts have been cautious in exercising power over such judgments but where occasion has demanded, where enforcement of judgment is manifestly unconscionable, they have wielded power without hesitation; litigants customarily invoke power by bills of review, bills in nature of bills of review, or by original proceedings to enjoin enforcement of judgment; relief granted has been setting aside judgment to permit new trial, altering terms of judgment, or restraining beneficiaries of judgment from taking any benefit from it; whatever form relief has taken, net result has been same; court has, in some manner, devitalized judgment even though term of its entry has long since passed away."

While space will not permit publication in full of the strongly worded dissenting opinion written by Justice Owen J. Roberts and concurred in by Chief Justice Harlan F. Stone and Justices Reed and Frankfurter, because the decision was arrived at by a bare majority of one and because of the legalistic technicalities involved, extensive excerpts from the minority opinion follow.

Justice Roberts in objecting strenuously to "resorting to a disorderly remedy," by setting aside established court practice which "repudiates the unbroken rule of decision with respect to the finality of a judgment at the expiration of a term," states as follows:

"No fraud is more odious than an attempt to subvert the administration of justice. The court is unanimous in condemning the transaction disclosed by this record. Our problem is how best the wrong should be righted and the wrongdoers pursued. Respect for orderly methods of procedure is especially important in a case of this sort. In simple terms, the situation is this: Some twelve years ago a fraud perpetrated in the Patent Office was relied on by Hartford in the Circuit Court of Appeals. The court reversed a judgment in favor of Hazel, decided that Hartford was the holder of a valid patent which Hazel had infringed and, by its mandate, directed the District Court to enter a judgment in favor of Hartford. This was done and, on the strength of the judgment, Hartford and Hazel entered into an agreement of which

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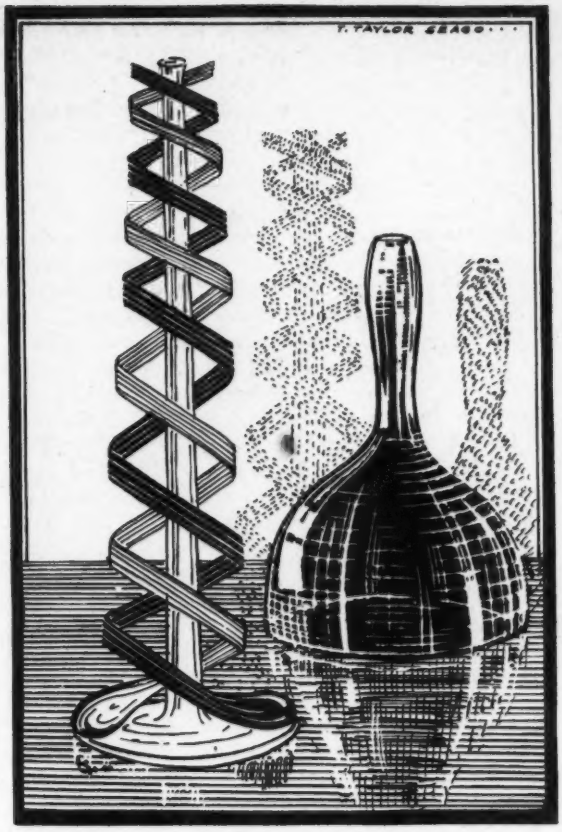
Glasshouse Friggers

Jacob's Ladder and Flip-Flop

By T. TAYLOR SEAGO



In the March issue two glass friggers of a musical nature, the bell and the bugle, were described. The flip-flop is yet another frigger capable of producing a musical sound, or at any rate an amusing and diverting double note.

This frigger is flask-shaped in form, with a fairly long narrow neck, generally constricted towards the body, and a quite flat, extremely thin, base. This base may best be described as a membrane of glass and acts as a diaphragm.

A gathering of glass is taken by the maker on his blowing iron and is swung out into a neck, the end remote from the iron being blown up to form a fairly large bulb. It is the next stage of the proceedings which calls for much skill in manipulation. The glass bulb is inserted into the mouth of a glasshouse pot and is rotated to and fro on the end of the iron. The lower part of the bulb tends to melt, and the action of rotation causes this softened portion to flatten out to form a disc-like membrane, already described. The illustration shows the flip-flop with the membrane acting as a base. The frigger is now detached from the blowing iron and the end of the neck is smoothed on a stone or file. If the neck is now placed to the lips and the air is gently sucked in and expelled, a series of notes will be produced. It is this sound which has given the frigger its name, for the notes very closely resemble the sound of "flip-flop" if this be spoken in a high-pitched metallic tone. If the membrane of this frigger should be too thick, no sound can be formed by the action described: if it be too thin the glass diaphragm will collapse upon suction being applied to the mouth of the neck. It will be realized, therefore, that much care must be taken in the formation of this membraneous base.

The Jacob's Ladder is a very decorative frigger and consists essentially of a long narrow tube standing upon a flared base—so that it is not unlike a herald's trumpet in form. Over this tube, resting upon the base and interlocking one with the other, are placed two spirals of glass. These are not usually circular in form, but rectangular as our drawing shows. They are formed by "spragging" open a pair of glassmaker's cutting-down tools or similar instrument, so that one end is much narrower than the other. Around this the maker will carefully wind a glass thread, finishing off with a bulbous end, to rest upon the base of the central tube. When two of the spirals are completed, they are interlocked and passed over the tube, which acts as a support for the whole. The two spirals are of different colors as a rule—thus the tube may be of white opal, and the spirals in red and blue. Though formerly made as an ornament, the Jacob's Ladder has been mentioned to the author as a toy in a budgerigar aviary, where the birds climb about the frigger in an amusing manner.

SIGNIFICANCE OF NEW DATA ON COMBINATIONS OF PLASTIC AND GLASS FIBERS

By FRANK W. PRESTON

The data in question are those set forth in a group of papers published in the May 1944 issue of *Modern Plastics*. These papers were written partly by officers of Wright Field, partly by members of the Research Staff of Owens-Corning Fiberglas Corporation, and partly by two plastics fabricators. I shall assume that my listeners have read those papers, or at least have a fair inkling of what is in them. A well-balanced appraisal of the possibilities inherent in these data is given by two officers of Wright Field, among the papers cited, at least so far as it relates to aircraft. This leaves me with a rather difficult assignment, for I have no fault to find with an appraisal which has already been given. Nor do I wish merely to repeat that appraisal. It is much better that you should read it for yourselves. Some of the significant contributions of the Preston Laboratories, on which we might with advantage spend some time, have not yet been cleared for publication, and I am thus in the position of being unable to discuss that part of the subject which I know best.

But perhaps my misfortune is your good luck, for much of it is highly mathematical, and I doubt whether all of you normally read mathematics for relaxation.

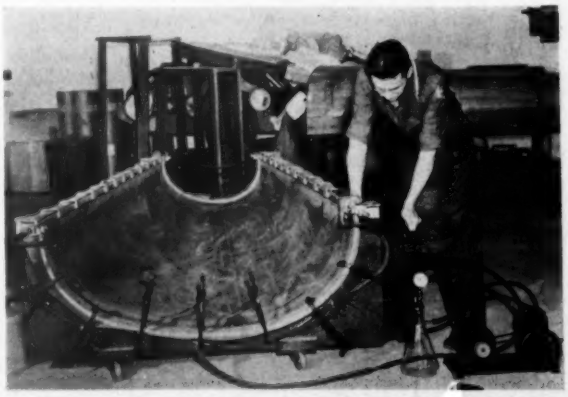
Now all of you, I believe, are men directly interested in plastics, and plastics men put fillers of all sorts into their plastics, and for a great variety of reasons. The reasons, of course, are invariably good reasons. The fillers always improve the plastics in some way, in fact, in just the way the plastics men want them improved for that particular purpose. But in any case, at the finish what he has is a filled plastic, or a reinforced plastic. The plastic dominates the picture: the filling is secondary, important at times, but still secondary. This is not the case with the material we now have under discussion. What we have to deal with is not a glass-reinforced plastic, but a plastic-supported glass net. The glass is the primary element; the plastic is a vital secondary one. It is secondary, but so important that I must apologize for calling it secondary. But none the less that is the case, and the significance of the new developments cannot be discussed, still less understood, unless we put first things first, and understand that what the plastics man has to do is to provide the means whereby the phenomenal properties of glass become available to the war effort or to the peaceful ways of living which we hope will shortly follow.

Therefore, I am going to talk to you about glass, not about plastics. You know all about plastics already. While I do not know all about glass, and some of you here are expert in the glass industry as well as in the plastics field, I have to hope that I can help you to appraise the possibilities of glass as a structural material, because that is the core of the matter. Once that is done, I feel sure that the rapidly developing plastics industry will provide the resins or plastics of the necessary technical properties, and in the volume and at the price which will permit the full exploitation of the structural possibilities.

All the glasses with which we need to concern ourselves are based on the properties of silica. It is true that most glasses commercially available in great volume and at low cost are not by any means composed entirely of this ingredient. The other ingredients are added for a variety of reasons, occasionally good reasons, but usually as a concession to the difficulty of melting pure silica. We should in nearly all cases prefer pure silica for technical reasons; and even for economic reasons, since sand is cheaper than any other ingredient. But it is just too hard to melt. So we compromise and add a flux, and the flux gets us into trouble, so we add other ingredients to offset the effects of the flux. Then one compromise leads to another, till we get all sorts of things in the glass.

The final result is a glass which has perhaps 75 per cent of the strength that might be expected of pure silica, if the pure silica could be prepared in exactly the same way. But even that 75 per cent strength is enormous. It is possible that if some day we can supply pure silica glass, you may be able to make even stronger structures with the support of plastics, but we do not need to wait for that day. Our glasses have plenty of strength in their initial undamaged condition. If they can be preserved from damage, and the strength preserved indefinitely, or for a long enough period, we do not need to await new developments in the field of glass composition.

Silica, which has the chemical formula SiO_2, would be regarded by plastics men, I think, as a "high



Fabricating glass-reinforced plastic fuselage. Plies of glass cloth impregnated with a resin are laid over a male mold. The plies, comprising a complete half of the fuselage skin, are trimmed before transfer to the female mold.

Fabricating glass-reinforced plastic fuselage. The impregnated plies of glass cloth are transferred to the female mold. A rubber blanket is laid over the plies and sealed on the edges. A vacuum is drawn with a small vacuum pump. Atmospheric pressure replaces high pressure autoclaves.

polymer" $(SiO_2)_n$ where n is very large. In the "amorphous" or non-crystalline form with which we are concerned, I think the picture may not be amiss, though the actual structure is probably considerably tighter than the system of carbon chains and rings which the plastics man usually envisages. Silicon, like carbon, is tetravalent, but the heat of combination of silicon with oxygen is somewhat greater than the energy involved in a carbon to hydrogen bond.

The silicon atom, or ion, is invariably found snugly packed in the tiny space between four oxygen atoms, arranged in a tetrahedron like a grape between four oranges.

Each oxygen atom is situated between two silicon atoms, to which it is equally bonded. Since tetrahedra cannot be packed solidly like cubes, the structure consists of alternating tetrahedral configurations and octahedral ones. The spaces are no doubt somewhat distorted in the non-crystalline variety of silica, and still more distorted in glasses containing ingredients other than silica. The important thing is that the structural bonds are silicon-oxygen bonds, which are very strong and quite numerous per unit volume.

As compared with metals, the obvious distinction is that the silica structure contains no "glide planes." Most of the pure metals have very pronounced glide planes, or planes of easy-slippage, and some directions upon these glide planes permit slips with almost infinite ease. Most metals, in other words, are almost infinitely soft and weak. They have to be strengthened by sticking pegs in the glide planes, a process known as alloying; or they have to be beaten up and crushed out of shape, a process known as cold working. Some two thousand years before Christ, I suppose, someone found that copper, a hopelessly soft metal, could be pegged and hardened and toughened by a judicious admixture of tin. So the copper age gave place to the bronze age, and the age of metals for utilitarian and warlike purposes came into being.

Previously gold and silver were the only metals known, and they were used largely for adornment and as precious things, as they still are used.

Now as a rule, alloying might be said to toughen, rather than to harden, a metal; or at any rate, it can be arranged so to do. Some ductility is left. The material does not break in a brittle manner when struck with a hammer. It can usually be dented slightly. Some metals of course must be hardened to the limit, whereon they become brittle, like high-speed turning tools. But in general we leave some ductility in them. This means, that we leave inside the metal a structure adapted to resist the indefinite propagation of cracks. This element of toughness is the great advantage that metals have. It is, however, somewhat opposed to maximum strength.

Plastics run into the same problem. The harder and stronger they are made, the more brittle they become. Thus as their ability to stand steady stresses increases, their ability to resist shocks goes down. This is one of the principal reasons why you use "fillers."

In the case of glass, or amorphous silica, the material is uncompromising. It has no glide planes, and it will not flow in the slightest till the temperature is raised so high that all the bonds are in a state of flux. Then its flow is viscous, not plastic. There are no preferred directions of flow like the glide planes: it will flow in exactly the direction of the applied stress.

But you are not concerned with its behavior at high temperatures, because you are not going to operate your plastics at those temperatures. You are concerned only with such temperatures as structures normally encounter on the earth or in the air. from perhaps 60 or 70° F below zero to perhaps 150° F above. However, if later on we need a material to work in much higher temperatures, and you can deliver the plastics, the glass industry will deliver the glass.

At this point I may interpolate a note on the variation of the strength of glass with temperature. Glass at room temperature has almost a minimum of strength; that is, it gets stronger as the temperature rises or falls. At 500° C or at 200 below zero, it is two or three times as strong as at room temperature. The true minimum is perhaps near 200° C; but this may not be strictly true of glass fibers, or of all glass fibers.

I return, however, to the question really under discussion; viz., the complete lack of ductility of glass at room temperature, or at any temperature short of its softening range. This brittleness has become a proverb, and is the principal reason why glass is looked upon as a weak and treacherous material. Because of the complete lack of ductility, a crack once started is very apt not to stop. The stress at the head of the crack rises to catastrophic values, and that is the end of the specimen.

But you may ask whether glass is not in fact really a weak material. Tests on laths, or on bottles, indicate as a rule a tensile strength below, rather than above, five tons per square inch (10,000 psi), which is certainly not a high value. The compressive strength is usually reported as many times the tensile value. But neither the one statement nor the other is an adequate presentation of the facts.

If we take a minute area of the surface of a bottle and measure its tensile strength, (which can be done) we find values from about 150,00 psi upwards. And in the case of glass fibers we find the same thing. These

(Continued on page 284)

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During April

Feeding, Forming and Shaping

In the manufacture of bottles such as those used for beverages where the charge of glass is fed first to a blank mold, a defect which occasionally occurs is the formation of a constriction within the neck immediately below the inner neck plunger. This constriction, commonly termed a "choke," generally results from insufficient or improper reheat before counterblowing. Any choke of major size is objectionable because it prevents the filling tube of the filling machine used by the bottler from properly entering the bottle neck with the result that the filling mechanism is broken or damaged. When this occurs the entire filling line must be shut down until repair is made and thus even a single defective bottle is quite expensive. Modern filling methods require rapid flow of liquid into the bottle and as a consequence the filling tubes are generally only slightly smaller in outer diameter than the inner diameter of the bottle neck, only sufficient tolerance being allowed to permit ready insertion and removal of the tube and escape of air during filling.

Internal restrictions or chokes are not readily detected in the usual visual inspection of the bottle and as a result a plug gauge must be inserted into the bottle necks to determine whether any chokes are present. This is an expensive hand inspection and is a burden which Harry P. Cox, Jr., of Lancaster, Pa. (Armstrong Cork Co.), has sought to eliminate by means of the invention covered by patent 2,347,181.

The main object of this movement in machine design is to provide a device which will automatically detect any objectionable choke in a neck of a parison after it is delivered from the blank mold and is in position for final blowing, and which is effective for controlling the supply of air for blowing the parison into a bottle so that if there is a choke in the neck of the parison a bottle will not be blown. These half-formed bottles which are not blown are readily distinguished by a casual glance of the inspector or may be discarded at the machine. The necessity of gauging each bottle during final inspection is eliminated. The apparatus by which this is accomplished is shown in Fig. 1, which shows two sectional views of a portion of a blow mold and blow head arrangement of conventional form with the Cox mechanism incorporated.

As shown in these drawings Cox has provided a tube 10 provided with a gauging end 11 of appropriate size, depending upon the size of the standard filling tube to be used in filling the bottles. The gauging end is so proportioned that it will pass freely into a properly formed parison as is shown in the left-hand drawing, but so that any choke in the neck of the parison, as shown at the right will prevent its entrance. It will be noted in the left-hand view that the movement of the gauging tube allows the blowing air to enter at S and to pass downward through the tube to blow the bottle. On the other hand, the imperfect bottle in the drawing at the right does not allow this blowing passage to open up, and the air is shunted through the waste vent at 20. The unblown bottle with a restricted neck is discarded.

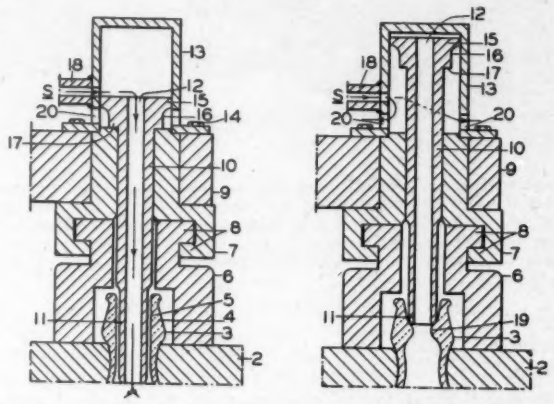


Fig. 1. 2,347,181: Cox. Neck gauge built into finish mold of bottle machine to reject parisons having constricted necks.

Lawrence O. Griffith of Port Alleghany, Pa., received patent 2,347,556 for a method of forming glass blocks with embedded wire mesh pressed into the glass forming the face of the block. This patent is assigned to Pittsburgh-Corning Corporation. The two views of Fig. 2 illustrate the steps by which the wire is forced to the middle of the glass section. The lower view represents an intermediate stage arrived at by laying the wire mesh on the soft glass and moving a ridged plunger into it so as to force the wire into the glass. The result is not wholly satisfactory since it will be noted that there is little or no glass cover at the points where the ridges of the plunger were in contact with the wire. This is corrected in a final step by applying another plunger whose surfaces make contact with the portions of the glass between the initial recesses, to fill the latter and thereby completely embed the wire within the glass. This final result is shown in the upper view.

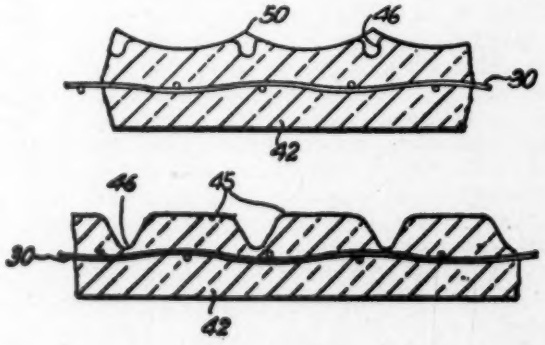


Fig. 2. 2,347,556: Griffith. Two step pressing to force wire mesh into the glass forming the face of a building block.

The Alien Property Custodian retains licensing rights for another glass block patent, 2,347,614, issued to Karl Rudolph of Dresden, Germany. He claims the method of producing blocks by forming two hollow mating sections with matching edges having inter-engaging lugs and recesses shaped to cause accurate positioning of the sections when mated, and to hold them properly spaced while assembling them with the lugs engaged in the recesses, heating the surfaces to be united to the fusing temperature, and pressing the sections together to unite the fused surfaces.

Patent 2,347,535, the latest of the group assigned to Norbert S. Garbisch by George J. Bair, concerned with the utilization of the purified product made from plate glass grinding waste, describes a method of making pressed glass tiles. The powdered material is hot pressed, and while still hot a glazing or decorative coating is applied, and then further heating fuses it into place.

Miscellaneous Processes

Victor Walker of Fort Erie, Ontario (AlnCin Inc., Buffalo, N. Y.), received patent 2,347,011 for methods of obtaining a deep etch in glassware. Chiefly he aims his improvement at removal of the retardation of etching which occurs with hydrofluoric acid as soon as the reaction products form. These products which include metallic fluorides quickly clog the area being etched, especially if the area is narrow, and prevent the attainment of the desired results. Walker reports that the results are quite different if an etching solution of ten parts sulphuric and one part hydrofluoric acid is used. The latter acid still has its etching effect but an improvement is obtained due to the action of the sulphuric acid which dissolves the metallic fluorides so that they do not build up to retard the process.

The manufacture of a specialty, the glass electrode for hydrogen ion determination, is dealt with in patent 2,346,470, issued to H. H. Cary and W. P. Baxter of Pasadena, Calif. (National Technical Laboratories). As normally constructed, Fig. 3, it consists of a thin bulb of low resistance electrode glass blown on the end of a glass supporting tube having a high electrical resistance. In use, the standard solution is placed within the bulb, and the exterior is immersed in the solution which is to be tested. A potential difference develops between the exterior and interior solutions and its measurement permits the exact determination of pH. The inventors relate the tedious prior methods sometimes used in making these electrodes and then outline their method which is exactly analogous to blowing soap bubbles. The tube, open on both ends, is dipped into molten glass so that a film will cover one of the open ends. This film is then blown to form a bulb of very thin glass.

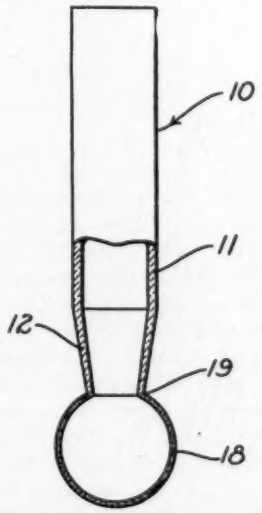


Fig. 3. 2,346,470: Cary and Baxter. Glass electrode for pH determination.

A further contribution to the art of chilling heated glass bottles to temper them is revealed in patent 2,345,808, granted to Thomas D. Green of West Hartford, Conn., Hartford-Empire Co. Green reports that it has been proposed to effect the chilling by means of air containing a mist of gaseous fluid or liquid spray, but that this sometimes condenses in the bottom of the spray nozzle inserted within the bottle. He therefore provides a modified nozzle equipped with what he calls an educator tube which continuously removes any such condensation.

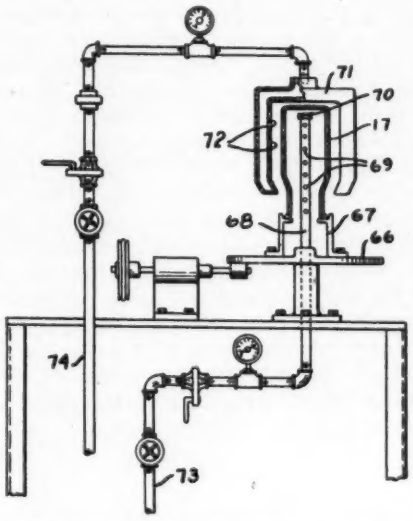


Fig. 4. 2,347,116: Littleton and Day. Apparatus for intensifying the air blast at the junction of sidewalls and bottom of a milk bottle to equalize tempering.

J. T. Littleton and Ralph K. Day also received a patent for tempering methods, particularly applied to bottles. This is 2,347,116, assigned to Corning Glass Works. They report the difficulties in the way of obtaining an even temper throughout the surface of ware in which the thickness varies. For example, in milk bottles the junction of the walls and bottom, being thicker, would tend to retain the heat abnormally long during chilling and for this reason would receive an inferior temper unless some extraordinary steps were taken. Littleton and Day outline a number of methods by which the chilling can be intensified at the thicker glass sections to accomplish more uniform tempering. These include liquid immersion methods and air quenching such as is illustrated in Fig. 4. This apparatus includes a power driven turntable 66 having a suitable group of fingers 67 on which a bottle is placed in inverted position. A fixed apertured tube 68 extends to within a short distance from the inner bottom surfaces of the bottle, the apertures being of a size and distribution to accord with the intensity of the chill to be given the various surface areas. In this illustration a single row of holes 69 serve to direct the chilling medium toward the inner sidewall as the bottle is being rotated, while apertures 70 are radially disposed about the cap of the tube so as to direct a number of streams of chilling fluid toward the junction of the sidewalls and

bottom of the bottle. A reservoir 71 has a row of apertures 72 faced toward the bottle to direct jets of air against its outer surfaces.

It will be noticed that the tube 68 and reservoir 72 receive their supply of cooling medium from two separately valved supply lines 73 and 74, thereby enabling (a) the use of two temperatures of chilling medium, (b) chilling the respective surfaces for different lengths of times or at different times, or (c) intensification of the chilling at one position by using a greater pressure of applied blast.

John S. Little of Westfield, N. J., assigned to Western Electric Co. his patent 2,347,421 for an apparatus for forming glass beads on wire such as electrodes. He provides a rotary machine into which the operator inserts wires of the proper length, charges a packing of powdered glass into a tiny mold through which the wire passes, and then supervises the successive steps in which the powder is first compressed by a plunger and then heated to fuse the glass bead around the wire.

Fig. 5 shows a detail of the supporting apparatus for tubes being conveyed through a furnace for annealing and straightening, as described in patent 2,347,156 granted to Miles Pennybacker of West Orange, N. J., and Albert R. Hussey of Lyndhurst, N. J. The tubes progress through the lehr by means of the pegs 18 attached to a conveying chain. They roll upon the slats 14 which action tends to remove bowing from the tubes. At given stations air blasts from the supply line 30 blow into the open ends of the tubes to remove decomposition products from coatings previously applied.

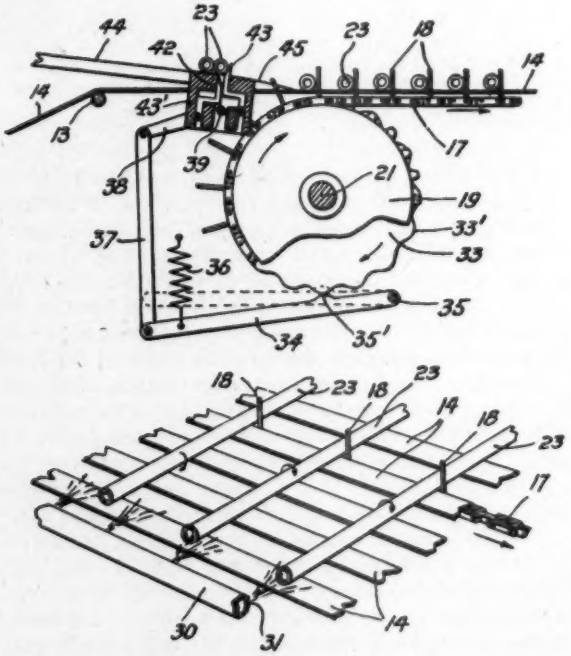


Fig. 5. 2,347,156: Pennybacker and Hussey. Details of conveyor within lehr for glass tubing.

Sheet and Plate Glass

Fig. 6 illustrates patent 2,347,382, the invention of Gerald White of Libbey-Owens-Ford Glass Co. for simultaneously bending and simultaneously chilling or tempering a number of glass sheets. The sheets 10 are heated while being suspended in a tempering furnace. Then a

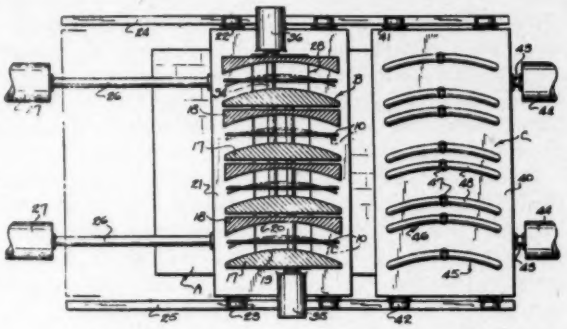


Fig. 6. 2,347,382. White. Chamber for simultaneously bending a number of tempered sheets.

series of convex and concave mold members for bending are moved into this chamber on their supporting carriage by plungers 26. Then the mold members are moved together to bend the sheets of glass between the convex and concave dies. A single plunger 36 moves all of the concave dies at one time, and another plunger 35 simultaneously moves the convex dies. The bending completed, the dies are withdrawn from the heating chamber and cooling or air blast units 48, supported on their carriage, are moved into place between the sheets to effectuate tempering.

Patent 2,347,608 to William Owen of Pittsburgh Plate Glass Co., covers an apparatus for copperplating mirrors and 2,347,176 to H. C. Doner of Toledo (Libbey-Owens-Ford), a supporting and carrying frame for mounting and carrying mirrors.

MANY USES FOUND FOR GLASS-ASBESTOS TEXTILE

The Owens-Corning Fiberglas Corporation is now producing a new textile by combining glass and asbestos fibers which is being used as a protective boot in war planes. In fabric form it is used for gun boots, tail-wheel boots, and—in the P-47 Thunderbolt—to protect retractable landing gear from the hot exhaust of the supercharger. In cord form the textile is used for shroud lines on military flares.

The textile is made either by combining glass and asbestos fibers to form yarns, or by combining glass and asbestos yarns in the weaving operation. The high strength of the material is primarily due to the glass, while the asbestos increases abrasion resistance.

• After thirty-five years in the same location, the New York office of the Mississippi Glass Company has recently moved to quarters at 200 Fifth Avenue. The new offices have been designed so as to utilize the company's Structural Corrugated glass with panels running from floor to ceiling, so there is an abundance of light.

GJ Research Digest

Practical Interpretations of Glass Technology

The Viscosity and Working Characteristics of Glasses

In part II of their work on the relation between viscosity and working characteristics Boow and Turner (*Journal Society Glass Technology*, October, 1943) have reported on some observations on the rate of cooling and viscosity of glasses during manipulation by hand.

Determination of the temperature by the use of thermocouples were made both at the surface and in the interior of 1 oz. and 3 oz. parisons and 4 oz. and 8 oz. bottles during the various stages of manipulation by a skilled hand worker. The temperatures at which it was possible to gather the different kinds of glass investigated from the pot (50 lb. capacity) on the blowpipe were also ascertained, in all cases by an optical pyrometer; in a few instances by a thermocouple. (It is of interest to note that the temperature recorded by the optical pyrometer is not that of the surface, but corresponds to that of some hotter, inner layer at a distance from the surface depending on whether the glass is colorless or exercises marked selective absorption. This phenomena is apparent when "gob" temperatures of amber and flint glasses are compared.)

The glass tested included the following types: a potash-lead oxide-silica; colorless soda-lime-silica for bottles, a cobalt blue soda-lime-silica, bottle glasses colored amber by iron-manganese and carbon-sulphur, respectively; and green by iron-manganese. Cooling curves were derived for the glass parisons, and comparison of the results were made with those based on the cooling, under closely controlled conditions, of glasses in a small laboratory crucible. From the temperature measurements the corresponding values of the viscosity in poises were ascertained from the viscosity determinations previously made.

It was concluded that the basic factors which determine the most favorable conditions for the shaping of molten glass are temperature and viscosity; and these are related to the composition of the glass, its color (diathermancy), weight of glass gathered and shape of article produced. Numerous tables and curves were given which showed the interrelation of these factors and of the compositions and gathering temperatures of the glasses with the times occupied by the successive stages of manipulation.

Glass for 1 oz. parisons could be gathered between the temperature limits 1300° and 1075° C (2372° and 1965° F), and viscosity limits 500 and 5000. The most suitable gathering temperatures and viscosities were for 4 oz. colorless and carbon-sulphur amber bottles 1125° C (2055° F) and 2500, respectively; and for 8 oz. 1105° C (1840° F) and 300. The mean viscosity values during the marvering of 1 oz. parisons of a colorless soda-lime-silica glass were as follows: (a) at the surface, start of marvering 13,000 poises, at end, 1,300,000; (b) at the interior, at start of marvering, 3200 poises, at end, 16,000. The considerably greater difference of temperature between surface and interior of the colored as compared with the colorless glasses during manipulation was shown to have a great effect on the speed of manipulation, a fact that has been indicated and proven by other studies on this subject.

Polariscopic Examination of Glass Container Sections

In the use of the polarizing microscope and polariscope for estimating the homogeneity of sections cut from various portions of glass containers, attempts have been made to predict the serviceability of the ware from the location and amount and type of cord observed. This problem has been studied by the Glass Container Ring Section Sub-Committee of the Standard Testing Procedure Committee and a tentative standard procedure for examining ring sections of glass containers has been developed (*Journal American Ceramic Society*, March, 1944).

The scope of the method is as follows: the ring-section examination is made for the purpose of judging the quality of glass containers with respect to inherent strains. These strains are usually the result of an inhomogeneous condition in the glass. An evaluation of these strains, especially tensile strains, assists in predicting the serviceability of the ware. The procedure is applicable to most commercial containers but not without modification to the ware which is purposely given a high compressive strain on both surfaces by processes such as tempering. The method, moreover, is not applicable to opaque glasses.

The equipment consists of a polarizing microscope equipped with a sensitive tint plate and a graduated quartz wedge assembly. The minimum requirement is that each shop be examined at least once every twenty four hours. The location at which the section is cut is standardized for each type of forming process. The examination is conducted by placing the ring-section in the immersion dish, covering it with the immersion liquid and focusing the microscope. The entire section in both positions of maximum birefringence color is examined and the following locations are noted (using the tint plate): location of the greatest tensile strain (1) on the outside surface of the specimen, (2) on the inside surface of the specimen, and (3) within the interior of the specimen. The tensile stress at each of these locations is then measured by the means of the graduated quartz wedge assembly.

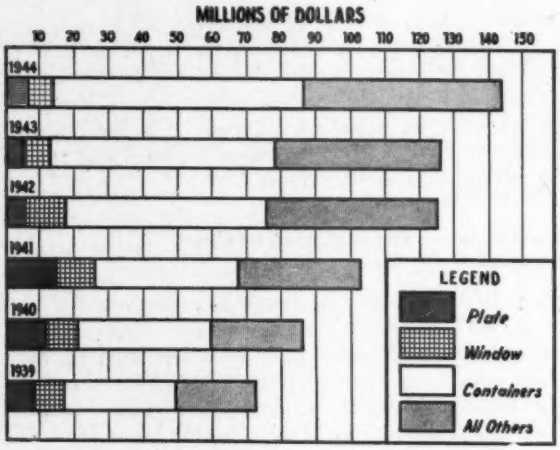
When the maximum tension stress has been determined for each of these locations they are weighed by the fol-

(*Continued on page* 282)

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX

Production: Three Months, January Through March



Activity in the glass industry during March showed an increase over that reported for February. According to the Production Index, output for March was $48,000,000 as compared with $43,000,000 for the same month of 1943.

Plate glass production for April totalled 8,079,119 sq. ft. as reported by the Hughes Statistical Bureau. This was a decrease of about 7 per cent from March, but an increase of 47 per cent over production in April, 1943. A total of 32,507,720 sq. ft. has been produced in the first four months of 1944.

Glass container production during April totalled 8,581,521 gross, according to the Glass Container Association of America. This was a decrease of 2 per cent from March, and an increase of 12 per cent over April, 1943. During the first four months of 1944 glass container production amounted to 33,436,157 gross, as compared to 29,216,299 gross for the same period of 1943—an increase of approximately 15 per cent.

Shipments of glass containers during April remained at about the same level as shown for March but showed an increase of 3 per cent over April of 1943. Total shipments for the first four months of 1944 were 5 per cent higher than for the same period in 1943.

Inventories on glass containers for April were 4,793,131 gross—approximately the same as reported for the preceding month. This is a decrease, however, of 18 per cent from April of last year.

Automatic tumbler production during April amounted to 5,511,559 dozens, an increase of about 30 per cent over April, 1943. Shipments of automatic tumblers during this month totalled 4,854,083 dozens, as compared with 4,935,510 dozens during the same month last year. Finished stocks on hand at the end of April were reported at 7,603,239 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware for April were reported at 2,005,136, a decrease of 44 per cent from April, 1943.

Miscellaneous glass products manufactured in March were estimated at $18,000,000—the same as the figure for February.

Employment and payrolls: The number of people working in the glass industry during March totalled

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures Are in Gross)

		Production April 1944	*Stocks April 1944*
Foods; Medical & Health Supplies; Chemical, Household, Industrials; Toiletries & Cosmetics	Narrow Neck	2,534,543	1,757,342
	Wide Mouth	2,787,089	1,402,039
Dairy Products		239,010	369,795
Home Canning		476,774	310,323
Beverages		687,380	305,004
Beers		974,586	143,941
Liquors		545,281	362,077
Wines		251,222	113,377
Packers Tumblers		85,636	29,233
Total		8,581,521	4,793,131

GLASS CONTAINER SHIPMENTS

(All Figures Are in Gross)

Narrow Neck Containers

	April 1944
Foods	545,631
Medicinal & Health Supplies	988,093
Chemical, Household, Industrials	580,253
Beverages	720,466
Beers	934,769
Liquors	482,720
Wines	242,352
Toiletries & Cosmetics	405,095
Sub-Total (Narrow Neck)	4,899,379

Wide Mouth Containers

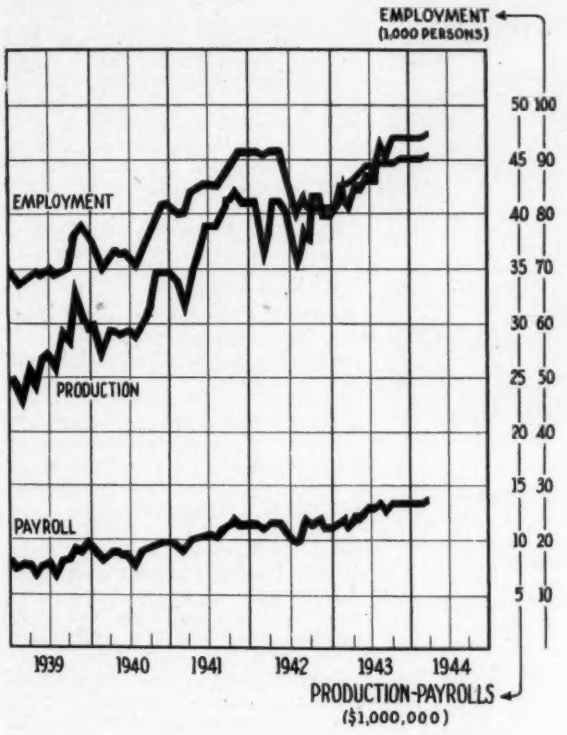
Foods	2,150,471
Dairy Products	210,625
Home Canning	447,964
Medicinal & Health Supplies	241,774
Chemical, Household, Industrials	154,797
Toiletries & Cosmetics	202,495
Packers Tumblers	85,453
Sub-Total (Wide Mouth)	3,493,579
Total shipments	8,392,958

92,000. This compares with 85,600 employed in March, 1943.

Payrolls in March were estimated at $14,000,000—an increase of $500,000 over February. This is an increase of 12 per cent over March of last year.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through March, 1944



WESTINGHOUSE ANNOUNCES VETERAN REEMPLOYMENT PLAN

The East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company has announced a comprehensive program for the reemployment of discharged service men and aid in the readjustments from military to civilian life.

The plan calls for the reemployment of all Westinghouse veterans and, whenever possible, for the hiring of veterans who worked for other firms before entering the service.

The key point in the program is a thorough analysis of every job in the big plant to determine those that can be filled with handicapped veterans. By checking a "job card" listing the qualifications for a certain task it is quickly determined whether the applicant is fitted for the work.

Attention . . .

Glass Tank Operators

***For Maximum Life* SPECIFY**

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CAST SUPER REFRACTORY

For

Mantels, Feeder Parts, Tuckstones, Burner Blocks, Port Covers, Port Bottoms, Port Arches, Port Skews, Port Baffles, Lintels, Jambs, Bridgewall Covers, etc.

C.S.R. *has excellent resistance to*

HIGH TEMPERATURES

CORROSION

SHRINKAGE

SPALLING

C.S.R. *is*

VACUUM CAST

ACCURATE TO SIZE

UNIFORM TEXTURE

ECONOMICAL

Write for Full Particulars

WALSH REFRACTORIES CORP.

High Grade Refractories for Over 50 Years

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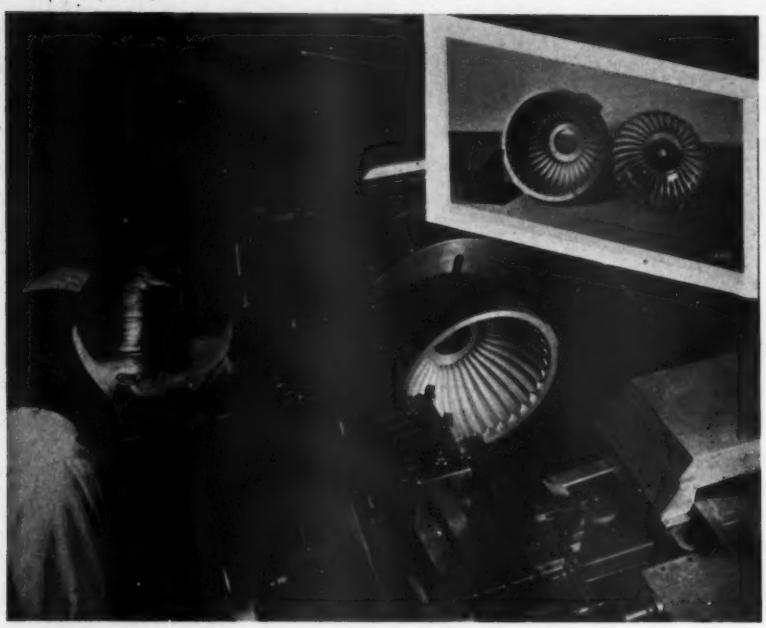
NEW EQUIPMENT AND SUPPLIES

SHAPE-TURNING LATHE ANNOUNCED



The Monarch Machine Tool Company, Sidney, Ohio, announces a new shape-turning lathe which will handle work up to 16 inches in diameter.

This latest "Shape Master" incorporates further refinements over the model introduced just prior to the outbreak of the war and almost immediately withdrawn to permit concentration on the all-out production of Monarch standard and toolmakers' lathes for the war program.

Oval-shaped bottle molds, dies for glass or plastic dishes, and punches or spinning chucks for silverware and hollow ware of all types can be machined with ease. For example, an oval dish mold with as many as 16 flutes can now be machined completely from rough to finish in only 2¼ hours—a fraction of the time ordinarily required to do such work. Moreover, the original mold can be duplicated *exactly* — not once or twice—but as many times as needed to put the product involved on a mass production basis.

The "Shape Master" mechanism consists of three elements. One controls the shape cut. Another regulates the rate of repetition of the shape on any given circumference. A third controls the contour generated on successive diameters.

The tool-actuating mechanism, mounted on the carriage crossbridge in place of the usual compound rest, is cam-operated. A cam follower is linked to the movable tool carrier—which rests on anti-friction bearings — and guides the tool in a shaper-like stroke which is adjustable from 0 to 2 inches.

The master cam itself records only a single element or unit of the desired design or pattern, whether oval, triangle, square, hexagon, or a non-geometric shape. In the fluted dish mold illustrated, for example, the master record would represent the curvature only of a single flute.

Repetition of the shape to be cut is determined by the geared relationship of cam and spindle revolutions. A single motor powers both, and the machine has been provided with sufficient change gears to give a range up to 500 shapes or tool actuations per revolution of the work.

The "Shape Master" further simplifies the complicated work of shape generation by making its own master record cams. Provision has been made whereby a simple, motor-driven cutting head can be substituted for the cam follower. Then an enlarged template of the section desired (only a segment is needed in the case of a symmetrical form) is chucked and a stylus or follower is substituted for the tool. The chuck is slowly rotated and the machine "works in reverse" to cut its own cam.

The overall contour of the work can be manipulated in two ways. A stroke-compensating device makes it possible to maintain the same shape over a constantly increasing or decreasing diameter of the work piece. Irregular contours can be obtained by the use of a metal template in conjunction with the Keller electrical controls.

CATALOGUES RECEIVED

Thermix Enginering Co., Greenwich, Conn., has just issued a new, illustrated Heacon Damper catalogue which provides helpful data on modern industrial damper problems. Included are a number of case histories and diagrams showing how proper damper installations have resulted in increased efficiencies on a wide variety of applications.

Discussions of such factors as binding in dampers, warped shafts, dynamic balance, power requirements, and simplified maintenance of damper installations will prove helpful to plant engineers and others charged with obtaining maximum efficiency in this phase of plant operation.

Ingersoll-Rand Company, Phillipsburg, N. J., announces a new 32-page catalogue of compressors and vacuum pumps in sizes from ½ to 10 horsepower. There are six pages of installation views showing various applications. The table of contents is arranged in the form of a chart which enables the reader to select the proper compressor for a given pressure and capacity. A number of cross-sections are given to show construction details and there are three pages of accessories and special purpose units.

Leeds & Northrup Company, Philadelphia, Pa., has just revised its Micromax Rayotube pyrometer catalogue to show how war plants have been applying Rayotubes and Micromax equipment to temperature-measuring jobs.

This 48-page edition embodies basically the same engineering descriptions as were presented in the 1941 publication but includes for the first time equipment being used to measure the temperature of molten cast iron, electric salt pots and blast furnace stove domes.

Fisher & Porter Co., Hatboro, Pa., is offering a new instructive catalogue on the F&P Rotameter, the area-type flow meter that measures the flow rate of liquids and gases. This catalogue, entitled "A New Era in Flow Rate Measurement," contains 32 pages of the latest information on this instrument.

CATALOGUE & BULLETIN SERVICE

Current catalogues and manufacturers' service bulletins received in this department may be obtained by writing to THE GLASS INDUSTRY.

SUPREME COURT DECREE . . .

(*Continued from page* 264)

more hereafter. So long as that judgment stands unmodified, the agreement of the parties will be unaffected by anything involved in the suit under discussion. Hazel concededly now desires to be in a position to disregard the agreement to its profit.

"The resources of the law are ample to undo the wrong and to pursue the wrongdoer and to do both effectively with due regard to the established modes of procedure. Ever since this fraud was exposed, the United States has had standing to seek nullification of Hartford's patent. The Government filed a brief as amicus below and one in this court. It has elected not to proceed for cancellation of the patent.

"It is complained that members of the bar have knowingly participated in the fraud. Remedies are available to purge recreant officers from the tribunals on whom the fraud was practiced.

"Finally, as to the immediate aim of this proceeding, namely, to nullify the judgment if the fraud procured it, and if Hazel is equitably entitled to relief, an effective and orderly remedy is at hand. This is a suit in equity in the District Court to set aside or amend the judgment. Such a proceeding is required by settled federal law and would be tried, as it should be, in open court with living witnesses instead of through the unsatisfactory method of affidavits. We should not resort to a disorderly remedy, by disregarding the law as applied in federal courts ever since they were established, in order to reach one inequity at the risk of perpetrating another."

In stating the rules governing the time limitation within which a district court may correct or modify its judgments and outlining the functions of an appellate court, Justice Roberts' opinion includes the following:

"The term rule applies with equal force to an appellate court. Over the whole course of its history, this court has uniformly held that it was without power, after the going down of the mandate, and the expiration of the term, to rehear a case or to modify its decision on the merits. And this is equally true of the Circuit Court of Appeals.

"The court below, unless we are to overthrow a century and a half of precedents, lacks power now to revise its judgment and lacks power also to send its process to the District Court and call up for review the judgment entered on its mandate twelve years ago. No such power is inherent in an appellate court; none such is conferred by any statute."

In emphasizing that Hazel-Atlas with full knowledge of the circumstances concerning the "fraudulent" article had not made use of the facts in an earlier action, Justice Roberts states in part:

"Counsel for Hazel was then, nearly ten years prior to the filing of the instant petition, confronted with the fact that, in its opinion, the Circuit Court of Appeals had accredited the article. Naturally counsel was faced with the question whether he should bring to the court's attention the facts respecting that article. As I have said, he asked and was granted five extensions of time for filing a petition for rehearing. Meantime negotiations were begun with Hartford for a general settlement and for Hazel's joining in the combination and patent pool of which Hartford was the head and front. At the same time, however, evidently as a precaution against the breakdown of the negotiations, Hazel's counsel obtained affidavits to be signed by the Messrs. Wood setting forth the facts which they had gleaned concerning the authorship of the Clarke article. These affidavits were intended for use in the Third Circuit Court of Appeals case for they were captioned in that case. Being made by reputable counsel who are accredited by both parties to this proceeding, they were sufficient basis for a petition for rehearing while the case was still in the bosom of the Circuit Court of Appeals. It is idle to suggest that counsel would not have been justified in applying to the court on the strength of them."

Further on in the minority review in connection with this particular phase of the proceedings it is stated:

"The customary modes of eliciting truth in court may well establish that in the circumstances Hazel's counsel deliberately elected to forego any disclosure concerning the Clarke article and to procure instead the favorable settlement he obtained from Hartford.

"In any event, we know that, on July 21, 1932, Hartford and Hazel entered into an agreement, which is now before this court in the record in Nos. 7-11 of the present term, on appeal from the District Court for Northern Ohio. Under the agreement Hazel paid Hartford $1,000,000. Hartford granted Hazel a license on all machines and methods embodying patented inventions for the manufacture of glass containers at Hartford's lowest royalty rates. Hartford agreed to pay Hazel one-third of its net royalty income to and including January 3, 1945, over and above $850,000 per annum."

At the close of the minority review Justice Roberts states his opinion as follows:

"In the present instance, I think it would have been proper for the court to permit the filing of the bill in the District Court where the rights of the parties to summon, to examine, and to cross-examine witnesses, and to have a deliberate and orderly trial of the issues according to the established standards would be preserved.

"I should reverse the order of the Circuit Court of Appeals with directions to permit the filing of the bill in the District Court."

WINKLE ELECTED VICE PRESIDENT OF FIBERGLAS CORPORATION

Owens-Corning Fiberglas Corporation has announced the elevation of Harry R. Winkle to the post of vice president.

Mr. Winkle will also continue to serve as comptroller and treasurer, a position he has held since the Fiberglas Corporation was formed November 1, 1938. He has been associated with Owens-Corning and predecessor companies since 1923.

SLIDEFILMS USED IN INDUSTRIAL TRAINING

The widespread and growing use of slidefilms in wartime industrial training has developed numerous new techniques by which the glass plant may improve the effectiveness of the medium, and determine its precise value as a supplementary teaching aid. Some method has been sought by which the industry, which undoubtedly will use more and more films of this type after the war, can, through tests, establish the value of the contribution the picture screen actually makes to industrial training skill.

Recently, The Jam Handy "Eye-School," in Detroit, worked out a simple method by which the personnel or training heads of any glass plant may actually test the effectiveness of the slidefilms used in training. This data resulted from a recent visual education and training "clinic" held at the school.

One phase of the problem of measuring the effectiveness of teaching films is the difficulty of preparing the visual tests. With pencil and paper tests, generally used, visual learning is measured solely by *verbal* response. But the verbal statement of a set of conditions given in an examination question may not present the problem concretely to the student.

Some student workers in any glass factory or plant can master a process from visual instruction and demonstrate their mastery in a machine or with objective materials, yet may lack the power to prove their understanding by writing about it. The Eye School clinic findings in cooperation with the U. S. Coast Guard, provide the employer with one solution to this problem.

The teaching, "discussional," type slidefilm is used in this test, which may be repeated by any employer interested, recreating the situation as it was learned. Portions of the pictures and words, phrases or complete sentences can be blacked out of the slidefilm. Then, when it is shown to the class, each student is confronted with the original conditions and with the task of supplying the missing (blacked out) words, constructions and other factors which the instructor has blacked out. This is, in effect, a completion test on both visual and verbal presentations of information.

The same slidefilm, and almost any subject will do for the test, can also be used for teaching.

To prepare the test, the instructor simply makes a paste of lampblack and water and applies it to the glossy side of the slidefilm with a small art brush. Those parts which are to be omitted in presenting the test are covered thus with lampblack, and in that way blacked out of the pictures as they are projected on the screen. After examinations, the lampblack can be easily removed with a slightly dampened cloth or by merely rubbing the thumb across the film.

In the accompanying photograph, the instructor is viewing a slidefilm over a plate of glass illuminated from below, and with an art brush is opaquing portions of the slidefilm not wanted in the picture when the slidefilm is projected as a test or examination. A mimeoscope provides just the right illumination, or an electric bulb placed in a shallow box with a frosted glass top can be easily improvised to serve the same purpose.

In checking test papers, the instructor in the glass plant foreman's school, for instance, or the class itself can again view the complete slidefilm—frame by frame—with the correct answers, or, the papers can be checked in the usual manner with a "key" prepared from the film.

Evaluation, including testing, is an important phase of the industrial instruction process. This particular refinement in testing places the emphasis on the *objective*, visual factors in learning, presents questions and problems clearly, because the student need not ponder the meaning of the question itself, but can concentrate on the answer to the question or the solution of the problem presented. This method of making simple evaluation tests of the slidefilm medium has been developed in cooperation with the United States Coast Guard, and, among other techniques, is widely used in the training given in that organization.

GLASS CONFERENCE TO BE HELD AT UNIVERSITY OF ILLINOIS

The Department of Ceramic Engineering of the University of Illinois is planning to hold a Glass Conference early in November in Urbana. This meeting will be the eighth of the series which was started in 1934.

These conferences have been planned as discussions of problems of interest to the operating personnel of glass factories. The program under consideration will consist of a survey of glass melting practice.

Tentative subjects of talks to be delivered by various men from the glass industry are as follows: Batch preparation, glass melting reactions, improvements in furnace design, furnace operation, temperature distribution in tanks, heat transmission through molten glass, postmortem observations of tanks, electric melting of glass and economic factors affecting location of glass plants.

Programs will be mailed to the personnel of glass companies as soon as the program is definite.

• Ed. Crane has been appointed industrial sales engineer in the Buffalo area for the Brown Instrument Co., Philadelphia precision industrial instrument division of Minneapolis-Honeywell Regulator Co.

ANOTHER INTERESTING CORHART REPORT

LAST month we published four pictures of a Corhart* Electrocast tank which had run 1199 days and produced 104,890 tons of flint and amber glass (153.3 tons produced per square foot per life).

We thought you might want to study the detailed figures. So here they are:

TOTAL DAYS LIFE	1199
TOTAL IDLE DAYS	48
TOTAL OPERATING DAYS	1151
TOTAL TONS GLASS PRODUCED (FLINT AND AMBER)	104,890.78
AVERAGE DAILY TONNAGE LIFE	87.48
AVERAGE DAILY TONNAGE OPERATING DAYS	91.13
SQ. FT. PER TON LIFE	7.82
SQ. FT. PER TON OPERATING DAYS	7.50
TONS PRODUCED PER SQ. FT. PER LIFE	153.35

This furnace was built of Corhart Electrocast throughout the melting and refining-end sidewalls, throat, doghouse and breastwalls, plus outer course bottom blocks in the melting and refining ends, and a section of bottom in front of the doghouse. All blocks were Corhart Standard except the throat, several superstructure shapes and two melting-end sidewall blocks beneath the No. 1 port, which were Corhart Zed. (Note the two Zed sidewall blocks shown in the photograph). The furnace operated approximately four months on flint bottle glass, after which it was changed over to amber.

The furnace *did not fail.* No patch blocks or waterjackets were used at any time on Corhart materials. At the conclusion of the campaign it was found that the furnace could have been operated for several additional months.

Corhart Refractories Company, *Incorporated,* 16th and Lee Streets, Louisville 10, Kentucky.

*Not a product, but a registered trade-mark.

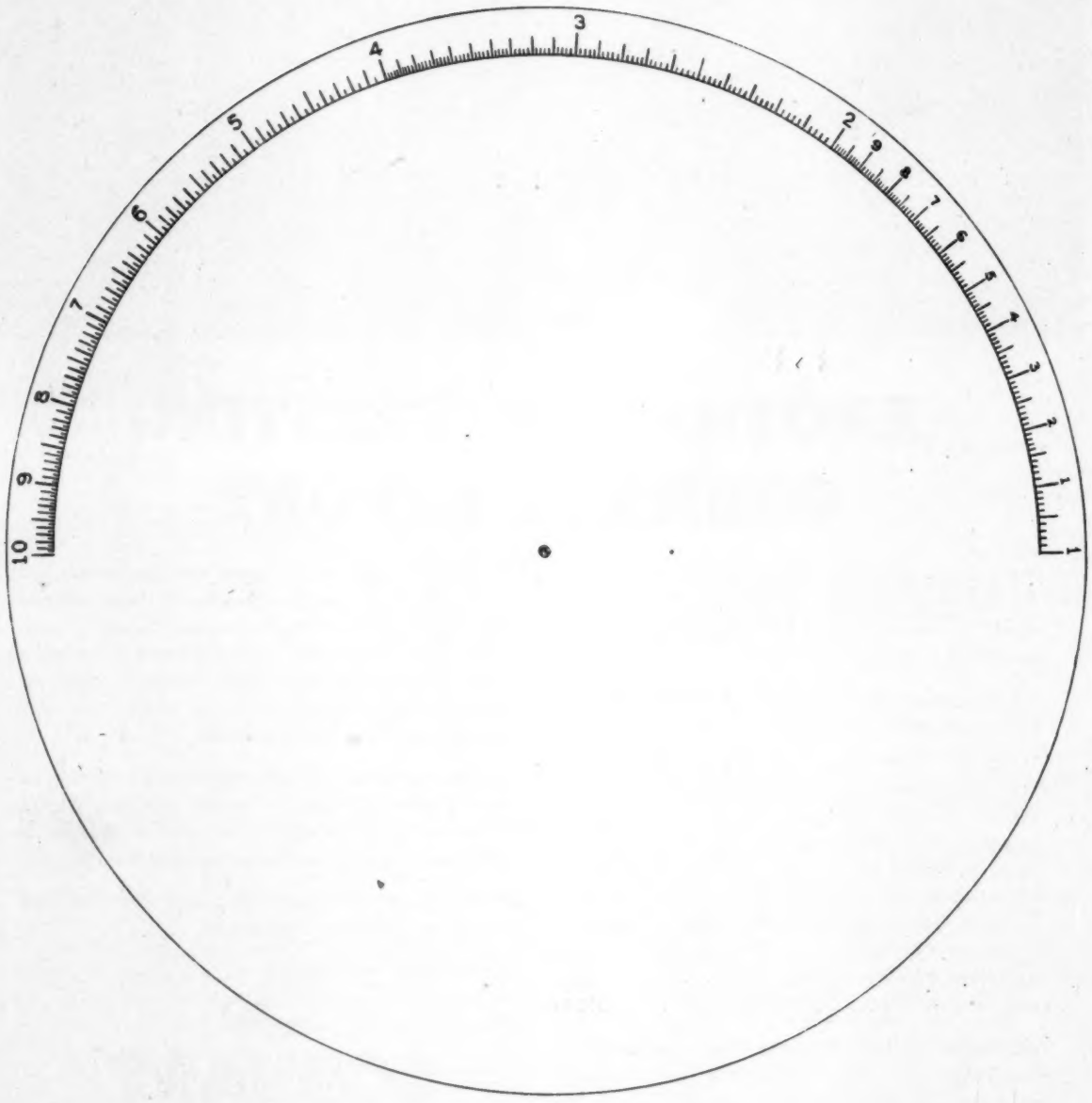
QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

444

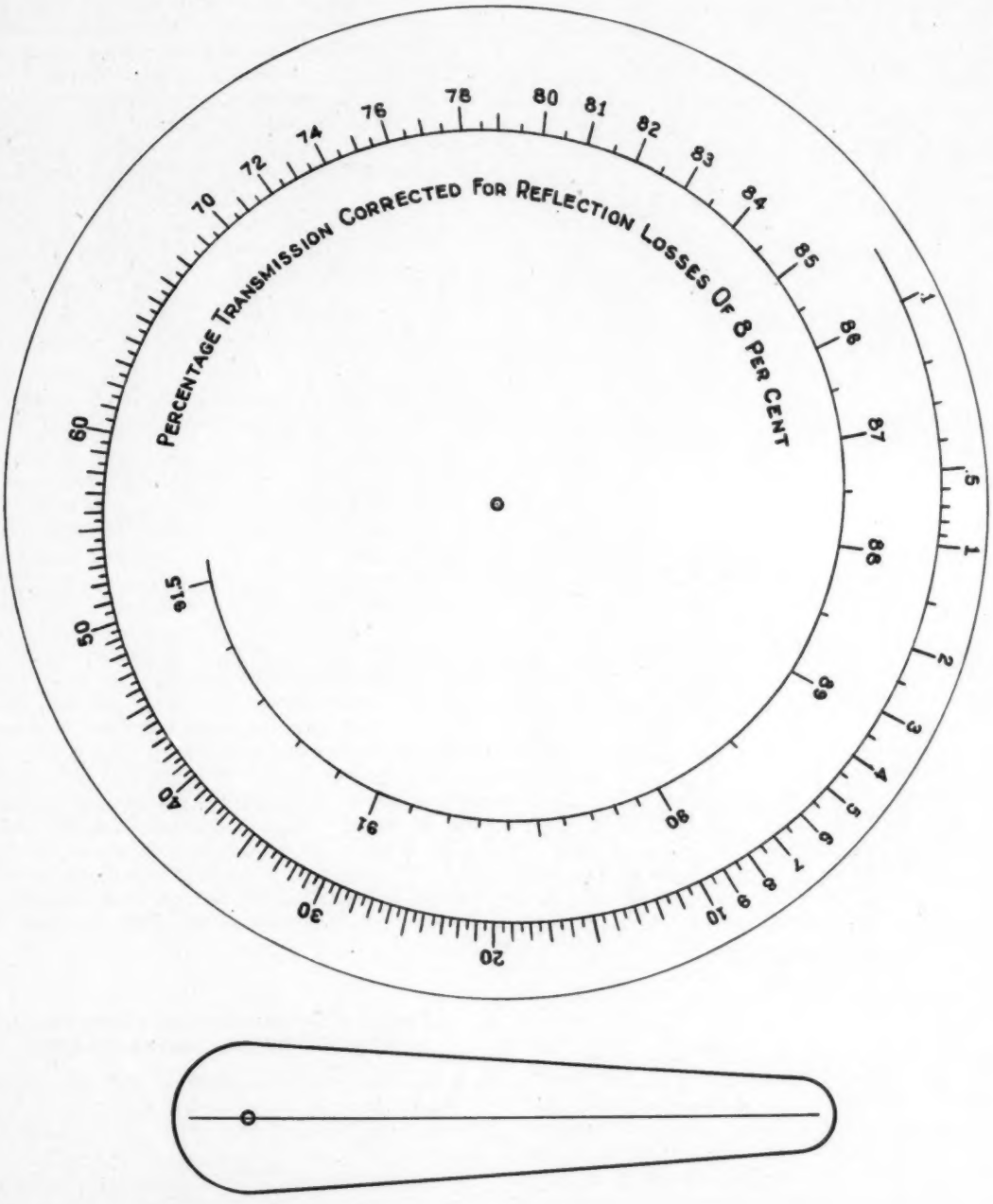
SCALE "A"

For a Calculator for Computing the Spectral Transmission of Glasses at Different Thicknesses



SCALE "B" and INDEX ARM "C"

For a Calculator for Computing the Spectral Transmission of Glasses at Different Thicknesses



COMPRESSED AIR EQUIPMENT . . .
(*Continued from page* 261)

scraped to fit the shaft and line up with the old ones.

It is generally impossible to adjust for wear on wrist-pins or bushings. Wear on these parts is usually slow. When either pin or bushing has worn to the point of becoming noisy, replacements should be made. In replacing new wrist-pin bushings be sure that the oil hole lines up properly with the hole in the connecting rod. A new bushing must be reamed out after it is pressed into the rod, for regardless of how carefully it has been machined a certain amount of distortion will occur when it is pressed into place.

Cross-head shoes in general wear very slightly and a shim or wedge is provided for their adjustment. Adjustment should be made when it is noticed that the travel of the piston rod causes a movement in the stuffing boxes due to wear of the cross-head shoe.

When stuffing box packing is replaced put in the rings so that the joints come at different points around the rod. Don't crowd the packing too tightly at first as it will squeeze out the lubricant and cause the packing to become hard. The gland should be drawn up only slightly. After the compressor has warmed up, it should be followed up just enough to prevent blowing. Fig. 1.

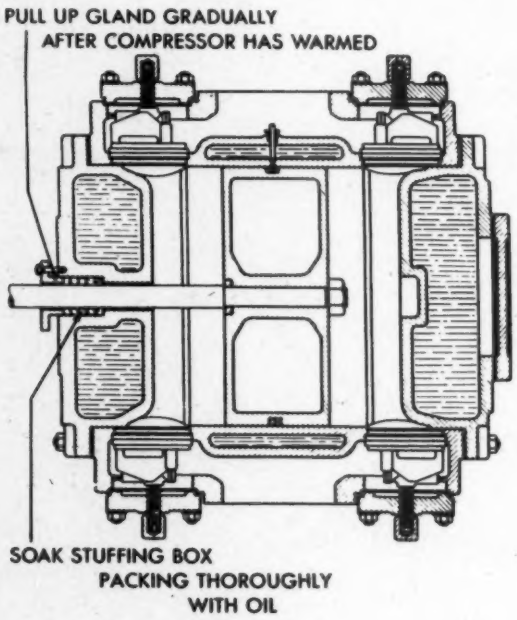


FIG. 1.

On a new compressor especially, a periodic check of the reduction gear and pinion alignment should be made. If the unit does not stay in line after proper alignment at installation, possible causes are: 1—settling, straining or springing of foundations; 2—pipe strains on turbine driven compressors; 3—bearing wear; and 4—springing due to heat from turbine.

Flexible couplings require very little maintenance when properly lined up. Certain makes of couplings require occasional lubrication to prevent excessive wear of springs or bushings. Coupling bushings should be renewed when wear has progressed to the point where the coupling is noisy.

V-belt drives require adjustment for belt tension. The belts will stretch slightly during the first few months of operation. Provision is made for taking up slack. A belt that is too loose will slip on the motor pulley and will cause undue heating and wear on the belts. A belt that is too tight will overload the bearings. Adjustments are made by sliding the motor along on its base. V-belts should be protected against oil and temperatures above 130° F., otherwise deterioration will be rapid. Do not use any belt dressing, resin or other adhesive substances on V-belts as they may cause temporary adhesion of belts to pulleys, but the contact surfaces will soon become glazed and the belts will slip more than before the application. If it is necessary to renew V-belts, install a complete new set. Any of the old ropes that appear to be serviceable for emergency use on future replacements should be kept, otherwise the new unstretched ropes, being shorter than the old ones, will carry nearly all the load, until their initial stretch is eliminated. This might cause strain or breakage.

NEW COATING PROTECTS WOODEN DEGREASING TRAYS

When wooden trays coated with compar, a vinyl resin derivative developed by Resistoflex Corporation, Belleville, N. J., are now being used by one of our large government arsenals to solve a health hazard which existed in the operation of degreasing lenses and prisms. After the etching process on lenses or the polishing and grinding of prisms, the optical elements must be degreased. Fitted into sockets in the trays to prevent scratching, they are dipped in a tank of tichlorethylene, a solvent which is a toxic hazrad at close contact.

When it became necessary to use wooden trays because of the shortage of metals it was found that workers were exposed to the dermatitis-causing degreasing solvent through the handling of trays that had been dipped in tichlorethylene. Although the trays were perforated to permit the solvent to drain back into the tank, they absorbed as much as 5 cc. of the solvent, rendering them unsafe to be handled. Now by a simple process of coating the perforated trays with compar, they are made non-absorptive, thereby safeguarding the health of all who must handle them.

JARRETT NAMED SUPERINTENDENT OF WESTINGHOUSE GLASS PLANT

Announcement has been made of the appointment of LeGrand Jarrett as superintendent of the Fairmont Glass Plant of the Westinghouse Electric and Manufacturing Company.

Mr. Jarrett was formerly glass specialist in the Lamp Division's purchasing department and liaison representative between manufacturing departments and glass manufacturers. He joined Westinghouse in 1913, being previously employed as an engineer with the Edison Storage Battery Company.

. . . Eliminate BATCH SEGREGATION this Modern Way!

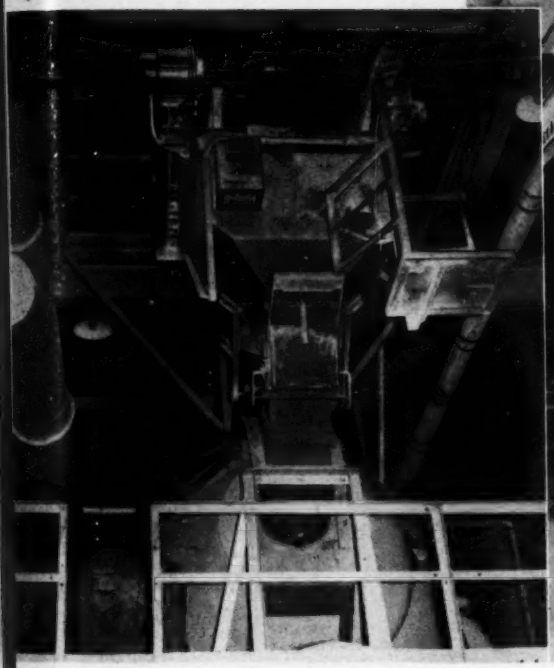


Photo at right shows a batch gathering car into which the ingredients are emptied in carefully weighed amounts from overhead bins. In photo above the ingredients are being discharged into the mixer automatically.

Of the dozens of ideas that have been experimented with for the elimination of segregation the Cleveland Tramrail method is the only one that has been used extensively and proven itself conclusively.

Cleveland Tramrail makes it possible to deliver batch materials from the mixer to the furnace, or to storage and later to furnace as needed, absolutely uniform just as received from the mixer.

A Cleveland Tramrail system includes equipment for gathering batch ingredients and delivering to the mixer.

Get the facts on this modern equipment. Learn how to sharply reduce cullet and produce better uniform quality glass.

OKLET No. 2009 . . . Describes glass plants
g Cleveland Tramrail. Contains engineering
and information valuable to glass producers.

GET THIS BOOK!

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
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MANUFACTURERS OF • CLEVELAND CRANES • CLEVELAND TRAMRAIL • STEELWELD BENDING PRESSE

CLEVELAND TRAMRAIL

OVERHEAD MATERIALS HANDLING EQUIPMENT

THE SHARP-SCHURTZ COMPANY

CHEMISTS AND CONSULTING ENGINEERS

FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.

For All Types of Glassware Moulds & Grey Iron Castings

OVERMYER MOULD COMPANY

Winchester, Indiana

For All Types of Glassware Moulds

OVERMYER MOULD CO. of PENNA.

Greensburg, Penna.

For Screw Machine Products

OMCO PRODUCTS CORPORATION

Springfield, Ohio

MAIN OFFICE . . . . WINCHESTER, INDIANA

GAS·AIR·OXYGEN
BURNERS
ECONOMIZERS
MIXERS
GLASS ROLLERS
GENERAL GLASS WORKING EQUIPMENT

Glass working equipment manufacturers: glass ampules, vials, etc. Glass working lathes, bench fires and laboratory equipment of all types. Write for catalog

CHAS. EISLER
EISLER ENGINEERING CO.
742-50. 13th STREET

RESEARCH DIGEST . . .

(*Continued from page* 271)

lowing empirical factors:

1. Multiply tension stress on outside surface by 1.
2. Multiply tension stress on inside surface by 2/3.
3. Multiply tension stress in interior by 1/3.

Whichever of these values is the largest is recorded as the stress index of the ware or relative ware quality grading with respect to permanent cord and/or annealing tensile stresses. Either the stress index or the individual tension values may be used to judge serviceability, inasmuch as permanent tensile strains in glass are an indication of the probable resistance of the ware to the temporary tensile stresses which may be imposed in service. (It is a matter of experience that the stress index may have a value of several hundred psi without measurably weakening the container.)

MONOPOLY APPEAL TO BE RETURNED TO SUPREME COURT DOCKET FOR FURTHER ARGUMENT IN FALL TERM

The Government's allegations of monopoly against certain firms in the glass container industry appear certain to go into their seventh year of litigation as a result of action by the Supreme Court on May 15, when the anti-trust case was ordered reassigned to the docket for further arguments the first week of the fall term in October.

The appellant firms, which include the Hartford-Empire Company, the Owens-Illinois Glass Company, Corning Glass Works, Hazel-Atlas Glass Company, and others, were asked to submit further argument on "the propriety of the terms and provisions" of the lower court's decision as they apply to the corporate and individual appellants.

In the lower court sweeping injunctions were decreed and the patent holdings of the litigant firms were ordered released to other manufacturers. Lack of limitation on unrelated patents and future patents gave the decree a sweeping implication which was severely attacked in previous arguments before the Supreme Court.

The Court said no further arguments were desired on the findings of the Lower Court with reference to alleged violations of the anti-trust laws.

Filing of the suit was based partially on the TNEC investigation of the Senate in 1938. Trial began in 1940 and was concluded in 1942. The Supreme Court heard arguments on appeal in November, 1943.

J. E. UNDERWOOD APPOINTED DIRECTOR OF RESEARCH AT DIAMOND ALKALI

The Diamond Alkali Company has announced the appointment of J. E. Underwood as Director of Research and he will be located at the Research Laboratories at Painesville, Ohio.

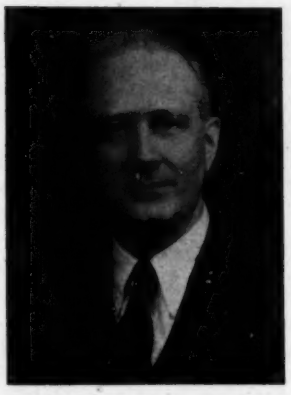
Previous to this position, Mr. Underwood was associated with the W.P.B.'s Office of Production Research and Development and has also been associated with Mellon Institute of Pittsburgh, U. S. Bureau of Mines, Radium Company of Colorado, Radium Emanation Corp., National Lime Association and the Pennsylvania Salt Manufacturing Co.

GLASS CONTAINER ASSOCIATION MEETING POSTPONED

The G.C.A. Meeting, which was to be held during May, has been postponed until June 21, 22 and 23. The location will be the same, namely, the Biltmore Hotel, New York City, and the schedule will be identical.

ASSOCIATE SECRETARY APPOINTED FOR AMERICAN CERAMIC SOCIETY

Charles Sidney Pearce has been appointed associate secretary of the American Ceramic Society and will assume his duties in Columbus on June 15.



In 1920, after several years with Weirton Steel Company, he entered the Carnegie Institute of Technology and in 1922 he withdrew to attend the Ohio State University, where he received his bachelor's degree in Business Administration in 1924.

After several years in private business Mr. Pearce was appointed assistant director of personnel for the Resettlement Administration in Washington, and was transferred with this bureau to the United States Department of Agriculture. In 1938 he became managing director of the Porcelain Enamel Institute.

OWENS-ILLINOIS PURCHASES SITE FOR GEORGIA GLASS PLANT

Owens-Illinois Glass Company recently announced the purchase of an 80 acre plant site south of Atlanta, Ga. The property, formerly owned by the Central of Georgia Railroad, was selected by the company during the early part of 1941.

Preliminary plans for construction of a glass container factory already have been completed by the company's engineering department but the actual date for starting construction will not be announced until problems of priorities and other preliminaries have been solved.

The company believes that the construction of a plant near Atlanta will place it in a better position to serve its customers in Georgia, Alabama, Florida, North and South Carolina, Mississippi, Tennessee and Louisiana.

Owens-Illinois Glass Company has maintained sales branches in Atlanta, Memphis and New Orleans for more than thirty years. A sales branch was established in Nashville about fifteen years ago and more recently branch offices have been set up in Jacksonville, Florida, and Charlotte, North Carolina. Thus, the company will have six well-established sales branches serving the area to be supplied by the Atlanta plant.

When the plant is built it will provide employment for about 300 men and women at the outset with a potential employment of 400 additional people when all furnaces are completed and in operation.

Gunite's Standard grade A
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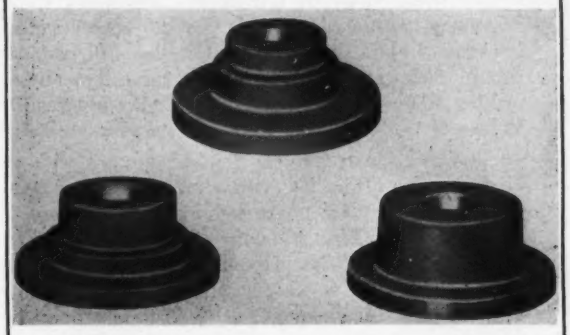
Guide Rings



Like all Gunite glasshouse castings Standard grade A is used for guide rings because it is best adapted to this particular purpose.

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DATA ON PLASTIC AND GLASS FIBERS . . .
(*Continued from page* 267)

values correspond with those of a very high grade, and usually very brittle, steel, and they are obtained with a material having only one third the weight of steel.

Now these values do not by any means represent the best that can be done with glass. Theoretically the strength of glass should be some millions of pounds per square inch, and in practice we succeed at times in making fibers of glass that go well beyond a million. Values of two or three million are sometimes obtained.

These high strengths seem to be normal with many kinds of glass, from pure silica to our common window glass or bottle glass types, but in most—perhaps all—glasses the very high strength is not permanent. This is certainly the case with pure silica, and with some other kinds. The Fiberglas Corporation believes that the particular composition they are using has more permanence than most. However, the highest value they normally claim is perhaps only one tenth of the theoretical strength, and not much more than 10 per cent of the highest strengths that have sometimes been observed. This last ten per cent is comparatively permanent with the better types of glasses, among which we may of course reckon the commercial glass fibers now available.

One of the causes contributing to the decline of strength of glass, a decline that appears to be spontaneous and without external cause, is very probably the adsorption up on the glass surface of atmospheric moisture. This condensation or adsorption takes place upon any glass, and apparently cuts the strength from a few million pounds per square inch down to a few hundred thousand pounds. The chemical effects of the water continue further, with some sorts of glass, but the glass used in commercial fibers is very resistant to this chemical attack.

Further the strength of fibers is greatly reduced by abrasion. Spoil the surface and you spoil all. It is therefore of the greatest importance to get the fibers into the plastic without abrading them. Since glass fibers must be twisted into yarn, and the yarn perhaps woven into a cloth or fabric, they are usually coated with a liquid film, oily in nature, as they are drawn in the first instance.

Before incorporating the fibers in the plastic, we need to get rid of all the moisture we can. We also want to get rid of the lubricating properties of the film. Our object is not to have two independent elements, a lot of glass filaments suspended precariously inside a lump of plastic. We want the plastic right up to the glass interface, supporting the fiber continuously. Otherwise, though we might develop some tensile strength, which is inherent in the glass fibers, we could not develop the compressive strength, which is inherent only in the *combination.*

Previously, I have mentioned that I found fault with reports that the compressive strength of glass was many times the tensile; in fact, I find fault with all the values reported for compressive strength. For the true compressive strength of glass is so high that I doubt if there is any means of measuring it. What is usually measured in a compression test is the imperfections of the apparatus, the failure to apply the stress uniformly, the creep at the contact face between glass specimens and steel platen, the stresses induced as the load is released, or something equally irrelevant.

With glass fibers, we have in effect very long slender columns. If we try to apply a compressive load to a column, and do not get it perfectly centered, or if the column itself is not perfectly straight, we get a most uneven distribution of stress. A very small imperfection in the set-up results in severe tensile stresses where we intended to have compressive ones. Now while glass can carry high tensions, it cannot carry infinite ones. The longer and thinner the column, the more certain are these catastrophic tensions. Thus the function of the plastic, so far as stress is concerned, is to support the filaments continuously, thus reducing the effective column length, and permitting the great compressive strength of the glass to become effective. This matter is touched on in one of the papers cited. The highly mathematical problems that this involves, and that still remain on a larger scale in conjunction with the use of relatively thin composite platen or airplane "skins", are discussed in a group of British papers, and, so far as they relate to the special combinations of plastics and glass fibers with which we are concerned in this paper, in a paper by H. E. Powell of this laboratory.

The significance of the new data we are about to discuss must be assessed therefore against this background of the properties of glass, or, if you like, of silica. Here we have a material so different from the metals that altogether new techniques are needed to make its properties available to the useful arts. Those techniques seem to mean, first the drawing of the glass into very fine fibers, and next, the use of plastics as the vital supporting element. The plastics, as we have said, also protect the fibers from abrasion. They act also as a bridge by which stress may be transferred from one fiber to another, and by the hydraulic action mentioned in another paper they frequently permit the glass fibers to operate in tension under favorable conditions.

The problems of the micro-stresses are so complex, that we shall not attempt to discuss them here. It is sufficient for our purpose that a combination of glass and plastics has been found entirely different from that in a laminated windshield, and having totally different potentialities. This new combination is not a glass-reinforced plastic, but rather a plastic-supported glass. The new data indicate that we have a structural material of great merit; they also indicate that its properties are not very similar to those of metals, or of concrete, or of wood or any other fairly well-understood material of construction. As a matter of fact, they more nearly approach the properties of the highly-stressed wing bones of birds than anything else.

The purpose of forming the glass into fibers is in some ways analogous to "refining the grain" in metals. It has the effect of stopping a crack before it goes very far. Whereas in a single crystal of metals, or in a single mass of glass, a crack is apt to travel completely through the specimen, in a glass fiber strand or yarn the failure of one fiber does not appreciably weaken its neighbors. The necessity for breaking each fiber individually gives the material exactly that element of safety which glass in the massive form commonly lacks.

(*Continued on page* 287)

GLASS IN THE WAR AND B_2O_3

In this war of materials, glass is playing a tremendously important part. Many kinds of glass are directly or indirectly aiding the over-all effort. From the lowly bottle or jar to the finest precision bomb-sight lens, glass is filling requirements that no other product can meet. Not all glass contains Borax or Boric Acid but in some glasses these products are absolutely essential, depending upon the specific use for which the glass is intended. Twenty-Mule-Team Borax and Boric Acid is directly contributing to the war effort where these materials are essential batch ingredients. Those manufacturers who are not now using Borax will find definite advantages in quality of product and manufacturing operations by inclusion of Borax in the batch formula.

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MODERN SCIENTIFIC ROLE FOR MEDIEVAL CROSS-BOW

Westinghouse research engineers are using the cross-bow, storied weapon of medieval times, as a helpmate to one of the most modern of scientific instruments, the electron microscope.

Made from tough, flexible steel and mounted on a wooden stock, the cross-bow shoots an arrow that draws out quartz filaments so fine it would take 60 of them to make the thickness of a human hair. The filaments—1/30,000th of an inch in diameter—are used to measure the magnifying power of the electron microscope.

When the Westinghouse engineer wants to replenish his supply of filaments he places the cross-bow in firing position and attaches a small, cylindrical piece of quartz to the end of the arrow. Using a very hot flame from an oxy-hydrogen torch, he heats the quartz until it is just about to melt. Then he pulls the trigger. The arrow darts from the bow at high speed, trailing behind it gossamer-like threads of quartz. Unbroken pieces up to 20 feet in length are not unusual but more often the filaments are dispersed in smaller sections throughout the route the arrow takes.

GLASS FIBERS HELP PREVENT CONTAMINATION OF BLOOD PLASMA

Dust which might contaminate the blood plasma injected into the veins of men wounded in battle, is strained from the air by glass fiber filters in the laboratories of Wyeth Incorporated, Reichel Division, Kimberton, Pennsylvania, where plasma is processed for shipment overseas.

BUY WAR BONDS

DATA ON PLASTIC AND GLASS FIBERS . . .

(*Continued from page* 284)

The purposes served by the plastic have already been discussed.

As things stand, the combination has a Young's Modulus of Elasticity between two and three million pounds. This of course is a measure of its stiffness, not of its strength. The value is comparable with that of bone, and is higher than most woods; but it is lower than glass, brass, or aluminum, all of which run around ten million, and much lower than steel, which runs around thirty million. It is vastly higher than plastics. In fact the figure represents the volumetric dilution of glass, of considerable stiffness, with plastic, of relatively trifling stiffness.

This loss of stiffness, of course, represents a gain in flexibility. This is very important for developing impact resistance, for what won't bend must break. This stuff doesn't break; in fact, more than any other substance having structural possibilities, it is "shock-proof" like the celebrated watches that are advertised over the radio.

The problems of the airplane builders have been largely responsible for the present search for fundamental data on plastic-fiberglass combinations. Some of these problems are immediate—a solution is needed at once. Others relate to the long-term prospects of aviation. Plastics are wanted for both structural elements, which may be highly stressed in flight or in landing, and for relatively unstressed "non-structural" parts. But the data thus accumulated will certainly be used for other industries than aviation, and for other purposes than war.

The major part of a paper presented to the Society of the Plastics Industry.

OWENS-ILLINOIS MAKES "DURATION" APPOINTMENTS

Announcement has been made of the appointment of acting managers for two sales division of Owens-Illinois Glass Company, temporarily replacing two executives on leave for wartime assignments.

E. J. Walker has been appointed Acting Manager of the Prescription Ware Sales Division in the absence of C. J. Koger who is now serving with the Navy, and W. M. Robertson has been appointed Acting Manager of the Pharmaceutical and Proprietary Sales Division filling the temporary vacancy left by Eugene F. Bertrand who is on leave with the War Production Board.

ADDITION MADE TO EXECUTIVE STAFF OF MELLON INSTITUTE

Dr. George H. Young has been appointed Executive Assistant at the Mellon Institute of Industrial Research. He has been associated with the Institute since 1935, first as Industrial Fellow, then as Senior Fellow, on the Stoner-Mudge, Inc., Multiple Industrial Fellowship on Protective Coatings. Dr. Young's new duties will be concerned with the management of research programs of the Institute.

SELAS CORPORATION CHANGES ITS NAME

Selas Corporation of America (formerly The Selas Company), consulting and manufacturing gas engineers, Philadelphia, announces official change of its corporate name. The action was necessitated by recent expansions, and by ramifications of the company's domestic and export activities. No change in organization, service, personnel or objective is implied. In the ceramic industry Selas is particularly known for its development work in direct radiant kiln firing with gas and in fire-polishing processes.

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